

CHEMICAL & METALLURGICAL ENGINEERING

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CHEMICAL & METALLURGICAL ENGINEERING

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S. D. KIRKPATRICK, *Editor*

JULY 1937

Applying the Rule of Reason

HE WHO FIRST SAID that competition is the life of trade told but a half-truth. Unscrupulous, unethical and unreasonable competition has destroyed many a growing enterprise. In this destruction some observers see but the inevitable workings of the law of the jungle, where only the fittest can survive. Others regard unbridled competition as inimical to the public good and would curb it with fair-trade laws and other legislative expedients. Yet somewhere between these two viewpoints there should be an area of self-government—an opportunity to apply the "Rule of Reason" to the solution of the most serious of these problems of competition.

One who has given a great deal of constructive thought to such problems has recently listed a number of points of competition between chemical manufacturers where ethical considerations are involved. First on his list comes price-cutting, whether in order to get more business or to retaliate for some supposedly overt act of a competitor. The reasonableness of the former course can be defended only when a manufacturer has lower costs than his competitors and has reason to know that with increased demand these costs will be reduced still further. Two other common points of competition arise from the introduction of substitute products or the entering of an established market. Here the rule of reasonableness would seem to insist that in each case the manufacturer contribute a product of higher quality or render better service at a lower cost. Otherwise he merely overloads the market without any advantage to the public. Yet this happens all too frequently in chemical industry and often to its detriment. "Stop, Look and Listen" warnings are certainly in order here.

Peculiarly chemical is the competitive problem of pricing byproducts. What to one manufacturer may be a byproduct costing practically nothing, may be

another's primary product that costs him a considerable amount to produce. In such cases the reasonable thing would seem to be to price the material at a level that would take up the volume of the byproduct and yet not disrupt entirely the market of the primary producer.

Should a large and diversified chemical company manufacture its own requirements? There can be no question of reasonableness if (a) the previous source is unreliable, (b) if the quality is unsatisfactory, (c) if prospective costs are sufficiently low to return a good profit on the increased investment or (d) if an otherwise wasted product or idle plant will be employed. But more than one chemical company has fooled itself on Reason (c). Experience shows that a return of at least 15 per cent on the total increased investment should be insisted upon. If lower by even a fraction, the benefit of the doubt should go to the current supplier.

When competition involves the violation of patents—whether that use be secret or open—it is obviously unethical. Yet borderline cases must occur occasionally and if we are to be fair and reasonable, any questionable step should be taken openly and preferably after an attempt has been made to solve the problem by negotiation, arbitration or, as last resort, by litigation.

A satisfactory solution for all of these problems might be quickly found if fair-minded competitors could sit down together and talk over their differences of policy and practice. But if an agreement is reached in such a meeting of minds, the question of legality immediately arises. On the other hand there is no law that will prevent a manufacturer from deciding these problems for himself, purely and simply on the basis of the rule of reason. And it is well to remember that reasonableness in business depends largely, if not entirely, on what is good for the industry as a whole and the public at large as distinguished from the immediate self interests of business competitors.

From an EDITORIAL VIEWPOINT

DANGEROUS THINKING ON LABOR COSTS

INVESTMENT COUNSELORS and other financial commentators have recently urged the purchase of chemical securities on the basis that this industry would not be seriously affected by the rising costs of labor. They cite census data to show that direct labor is a less important element in chemical costs than for most other commodities. This is only true when one disregards two important facts, viz., (1) That technical control and administration, including research and development, are proportionately higher in chemical industry than in other fields and, (2) in the last analysis, labor is by far the single most important element in all production costs. Therefore to imply that chemical industry can afford to disregard or will not be seriously influenced by rising costs of labor seems to us an extremely short-sighted view.

At a time when national legislation covering wages and hours of work is under consideration in Washington, it would be well to point out that there can be no fixed relation between wage rates and the value of the product or, what is generally termed, "value added by manufacture." Too many other factors are involved which the labor agitators in Washington have refused to consider. The fixing of wage rates, it seems to us, is primarily a matter between the employer and the employee, but if they must be fixed by law, schedules should be made on a geographical basis rather than for any single industry or product.

REWARDS FOR SAFE TRANSPORTATION

LAST YEAR the chemical industry made a marvelous record for safety in the transportation of its products. A few careless workers splashed by acid did suffer burns; but no one was seriously injured and no one died as a result of the handling of hundreds of millions of dollars worth of chemicals by the railways of America. The money loss incident to handling these so-called "dangerous articles" was less than the value of a single carload of most goods, only a few thousand dollars for the whole year for all of the United States.

This record, only a trifle better than the average for recent years, is an evidence that cooperation between shippers and carriers has been effective. The problems have been many; but these have

been solved, and the "take a chance" attitude has been eliminated.

Chemical shippers can now rightly ask from the railways one reward for this achievement. It is at least fair to ask that all spokesmen for carriers cease claiming that chemicals are costlier to handle because they are so dangerous. They may be more costly in the sense that they require special packaging, placarding, and careful handling, but the element of hazard and the cost of hazard is no longer a proper element in considering freight rates.* Certainly the record proves the case.

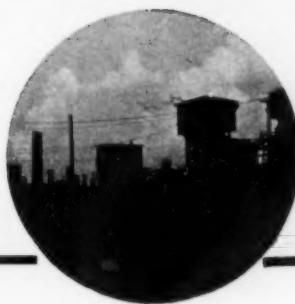
MORE OF THE PARTNERSHIP SPIRIT

A LONG STEP forward in personnel health service was announced recently by du Pont. This firm now assures its employees that when they are absent on account of illness or non-compensable accident they will still, after a brief waiting period of two days, regularly receive their wages or salary. Never before has a large enterprise made such a generous arrangement to cushion the blow which illness or accident can cause.

Perhaps there are not many other chemical firms that can afford to follow this most generous plan. But it does point the way for sound management thinking in our industries. Some such plan is certain ultimately to become a natural and logical part of improved personnel relationships in all the chemical industries, where sincere co-operation of everyone from the top executive to the common laborer is essential for safety as well as profitable operation.

Many social and actuarial questions will arise. Some will feel that a two-day waiting period is too short. Others will think that full pay is too much to accord, offering too little inducement to the worker to get back on the job. But there is always the other side of such questions. A long waiting period imposes a hardship altogether antagonistic to the purposes of such a plan. And part pay is least satisfactory at a time when expenses are apt to be highest.

It is important that all these questions be well studied by each firm before it embarks on a new program. The costs should be carefully calculated and a basis established for cooperation with the personnel and with the medical profession in each locality where any large number of company workers live. Some scheme may be necessary to



take care of hospitalization and surgical expenses. And a score of other difficult questions must be faced and rightly answered.

These plans must not be allowed to become unduly costly or they will fail under economic stress. But we may well assume that some such plans are going to be a part of tomorrow's business relations between company and worker. They form a part of that spirit of real partnership which is growing. One can only hope that this spirit of cooperation and partnership can grow without the blighting effect of either unreasonable labor leadership or of stubborn corporation management. Sincerity and responsibility on both sides are required to make even the most generous personnel plan a really lasting success.

BLOWING THE "HORN ANGLE"

NOT LONG AGO a leading New York newspaper reported a new and revolutionary process for extracting cellulose from trees and other products of the soil. It was hailed as "promising the dawn of a new era in the manufacture of paper, textiles, sugar, food products, medicines and a host of other essentials of present-day life." Developed by Matthew J. Stacom, self-taught engineer and president of the Island Lumber Co. of Long Island City, N. Y., the process apparently had the approval of Professor H. M. Ullman, head of the Department of Chemical Engineering at Lehigh University, who was credited with stating that the results obtained have hitherto been regarded as belonging to the "impossibles" of engineering.

Essentially, the process centers around a unique "horn-angle machine" which has been "designed on relatively simple principles, but is capable of producing pressures from 100,000 to 140,000 lb. per linear inch (sic.)—pressures so tremendous that their attainment on a commercially practical scale so far has been considered an unrealizable dream."

These unusually high pressures are obtained "by the utilization of a new discovery on the horn angle, that mathematical entity which has puzzled the world's greatest mathematicians for the last 2500 years, from the days of the Greeks to the present." In the Stacom machine, two steel cylinders are placed one inside of the other—"the relative proportions of their respective diameters being such as to form horn angles of definite

sizes, and obtaining a correlated effect of horn angles operated in different planes, thus obtaining extremely high pressures, provided the inner and outer cylinders are made to rotate simultaneously in the same direction."

Several prominent chemical engineers in the cellulose industries of the United States and Canada have repeatedly attempted to see the process in operation, but apparently that privilege has been accorded to only a very few. One investigator who has made a report to his principals on the process, cites the following objections: (1) "The necessity of reducing the wood to narrow strips by sawing or other means is a great disadvantage. (2) Sawing involves an additional operation, yielding 25 per cent or more of sawdust, which is of little value. (3) The wet wood is reduced to fragments varying in length from a few inches to a small fraction of an inch. (4) Much of the wood would be so small that it would give trouble in cooking. (5) The great pressure reduces the water content but does not in any way change the lignin content of the wood as is claimed by the inventor.

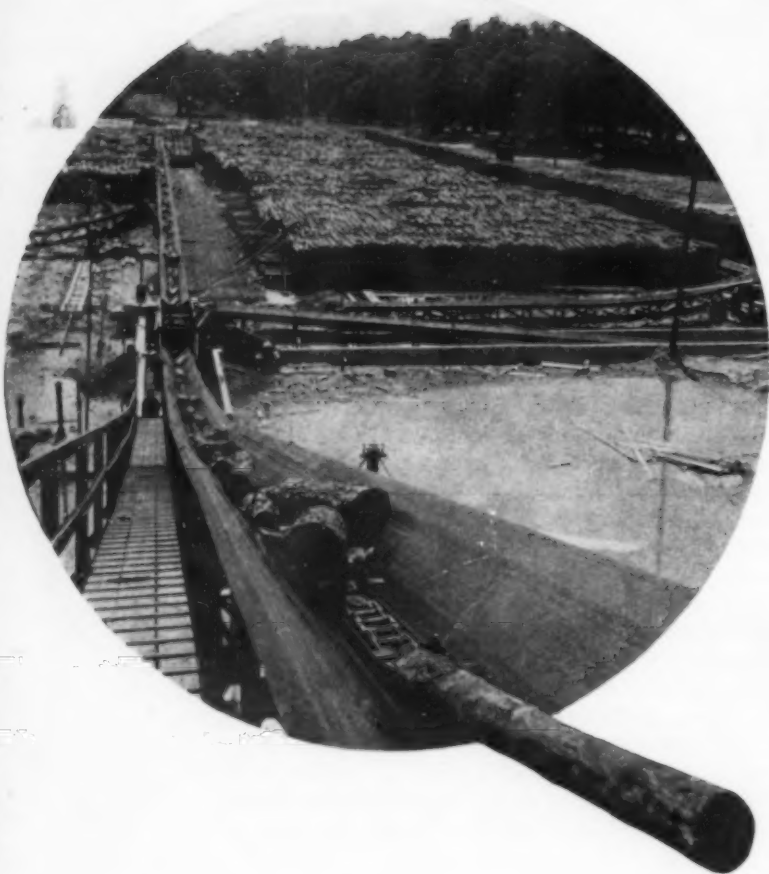
The "horn angle" has proved most effective, it seems, as a method of getting newspaper publicity. One cannot help but wonder, however, if it would not have been best for the chemical engineering profession if the blowing of this particular horn had been left entirely to the promoter.

SELENIUM FOR ALMA MATER!

A MINERAL EXPERT was recently solicited by the Harvard Fund. He replied as follows:

As I am an aluminum of two other colleges besides Harvard, and can not, with my bismuth in its present state, pay antimony to all three, I hope you will not think me a cadmium if I do not caesium this opportunity of making a donation. So far this year I have metal current expenses, but in these troubled times when the future holds in store we know not phosphorous, I could not make a contribution without boron from the bank. It would nickel out of my savings. A manganese spend his dollars these days; a tin spot is gone in no time. One is lead to feel he is pouring them down the zinc. Much better to sodium up in a stocking. But don't be silicon not make any contribution this year.

The Fund wrote him simply: "Iron stand you." But as alloyman, mica suggest opening up a bro-mine and issuing stock certificates with the promise to selenium for dear old Alma Mater?



PAPER MAKING

Southern pine in the wood yard of the large Savannah, Ga., pulp and paper mill of the Union Bag & Paper Corp.

JUNE 14 was a red letter day in the history of the Union Bag and Paper Corp. for it marked the inauguration of operations in the second unit of the company's great kraft pulp, paper and bag mill at Savannah, Ga. Under the supervision of J. M. Allen, vice-president, D. G. Moon, chief engineer, and E. H. Mayo, consulting engineer, there was remarkable coordination throughout the mill as can be best demonstrated by the smooth operation of the paper machine. Only 14 minutes were required from the time the pulp first spread over the fourdrinier wire of the machine running at the rate of 1,000 ft. per min. to form, dry and wind the completed paper.

This great mill of the Union Bag organization is of particular interest as it was the first of the new group of kraft mills to be built in the South. As the company had never before made this type of pulp, it was not handicapped in the planning of this mill by tradition. The layout and equipment represent the best present-day practice.

Two years ago ground was broken for the first unit of the plant. A year later production commenced. The average daily production of that unit is about 200 tons of kraft pulp and 150 tons of bags and wrappings. Construction of the second unit was started in September of last year. This unit was designed to duplicate the capacity of the first unit and to make 40,000 tons of kraft paper annually. The third unit, which was commenced the first of the year, is now about two-thirds completed. It will probably be ready to operate in October, 1937. The daily capacity of the three units combined will be 700 tons of pulp and 600 tons of bag and wrapping paper. Provision has been made for lapping and drying surplus pulp for shipment to the company's northern mills.

The site for the mill was selected on the Savannah River at a point about a mile from the city. It was a portion of the very historical Hermitage Plantation, settled about 1782. In 1815, a deposit of clay on the place was found suitable for the manufacture of brick and was put to this use two years later. In 1820, the first steel railroad in America was laid from this brick yard to the city of Savannah. D. W. Griffith brought the plantation into prominence in 1915 when he and his company of actors spent about a year there in producing the silent motion picture "Birth of a Nation."

As straight-line production was followed in laying out the mill operations the wood yard is located at one end. It has recently been enlarged to take care of the increased production. It is now served by three parallel lines of conveyors, each 1,100 ft. in length. Wood is brought to the mill by railroad, truck and barge from the neighboring timber lands. The conveyors transfer the wood to the two chain suspended barking drums for the original unit and two under-slung drums for the new units. These drums revolve slowly, causing the wood to tumble, which rubs the bark off as each piece is thrown against another. The bark is conveyed on a belt to the boiler room where it is burned. The wood drops out of the drums onto a conveyor, which takes it to the wood room.

Wood Room

The equipment in the wood room has been laid out so that the original unit may be used for special cooks of pulps, if it should be desired. Two additional chippers, five vibrating screens and two chip crushers have been installed recently.

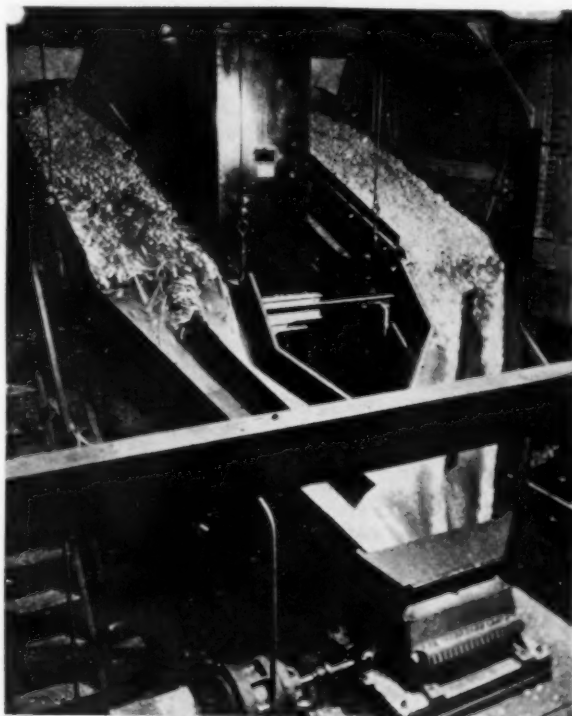
The wood from which the bark has been removed passes from the conveyors into the chippers where it is cut into small chips. These are conveyed to the bottom of an elevator, which lifts them to the top of the shaker screens, located on an elevated platform. Chips that are of the desired size pass through the first screen and are discharged from the end of the second screen underneath, directly to a conveyor belt. One 18 in. and one 24 in. five-ply rubber belt 480 ft. in length, carry the selected chips from the wood room to the digester bins, located above the digesters. These belts are carried up a structural steel bridge.

When the installation is completed there will be 13 steel digesters, each 7.8 tons capacity, arranged for both direct and indirect cooking with liquor circulating pumps.

AT SAVANNAH

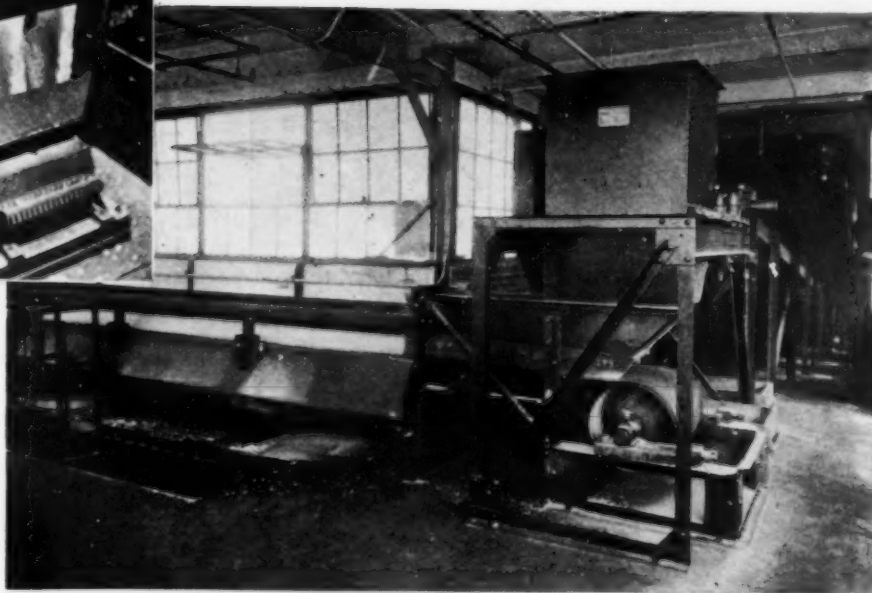
By JAMES A. LEE

MANAGING EDITOR OF CHEM. & MET.



Two chip screens remove the sawdust and slivers at the Union Bag mill

Chips are brought up to the bins above the digesters on a 480 ft. belt to be seen on the extreme right. Chips fall through the grating on the left into the bins



In the first unit there are four digesters and in each of the other units three digesters. The pulp made in the first unit is washed in 12 fusion welded diffusers, arranged around a circular concrete tank. The pulp in the second and third units will be washed in 28 diffusers arranged in four circles of seven each. Each unit is provided with a separate concrete dump chest under the

diffusers, each holding about 40 tons of pulp. For the recovery of heat and reduction of odor, an additional condenser and accumulator is being installed for the two new units to reduce the steam relieved during the blowing operation.

When the cooking is completed the valve on the bottom of the digester is opened and the steam pressure within the digester blows the entire contents up through the separator above the diffuser room, where the steam is separated from the pulp. The pulp goes down into the top of the diffuser tank and the steam goes back into a condenser. The diffusers have false screen bottoms which hold the pulp and permit the cooking liquor to drain off. This solution goes back to the recovery room for recovery of chemicals. After the cooking liquor has been drained off the pulp is next washed, in order to save any additional chemicals. The ordinary manner of operating diffusers is to wash them in pairs. When the wash liquor becomes very weak in chemicals it is no longer sent to the recovery department, but instead is passed from one diffuser to the top of the next one and is there used as a primary wash.

Washing and Refining

When the washing is complete the pulp is drained out into the large tanks below. There is one tank with a capacity of 40 tons of pulp for each group of washers. From these tanks, which serve as temporary storage, the pulp goes to the stock preparation room. Here the refining is done. The knots and uncooked chips are re-

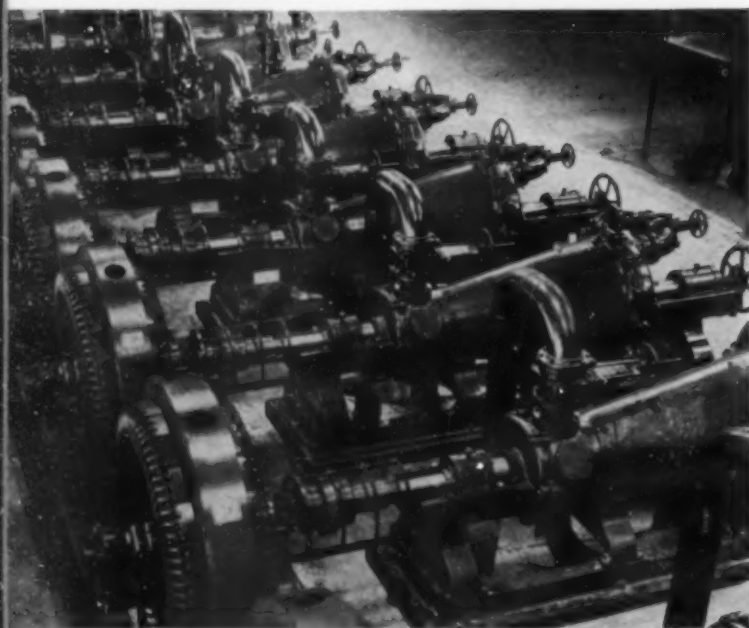
moved and the clean stock is passed through thickeners. The pulp then discharges from the thickeners into the stock tank beneath the floor. As required it is pumped through one of the 34 jordan refiners which serve to reduce the fibers to a length, thickness, and pliability that makes them suitable for converting into paper. From these refiners the pulp discharges into concrete mixing



Several of the 13 digesters, each 7.8 tons capacity arranged for both direct and indirect cooking



Pulp in the second and third units will be washed in 28 diffusers arranged in four circles of 7 each



Thirty-four jordan refiners serve to reduce the fibers making them suitable for converting into paper

tanks with parallel agitators where the rosin size, alum and other chemicals are added. It is then pumped to the tank located at one end of the paper machine and converted into kraft paper.

The screening of the pulp from the three units is accomplished by eight knotters, nine primary centrifugal screens, three centrifugal tailing screens and five flat screens. These are arranged for separate or combined operation of the individual units.

The two paper machines for the first and second units are installed in one room, while another room is being built to house the third and possibly a fourth machine. These machines produce a roll of paper 234 in. wide.

A beater which pulps the scrap paper is located in the basement beneath each machine. They are cast iron tanks built with steel rolls of the keyed bandless type and with the recently developed braced bar construction. The roll is supported in double suspension spring bearings of cast steel and arranged to cushion the roll against shocks in both upward and downward direction. These continuous beaters have both the perforated backfall and perforated bedplate extractors.

Both the first and second machines have been equipped with an 8-roll calender stack. The third machine will have two stacks. Each machine room will be provided with a 15-ton traveling crane which will handle the rolls of paper.

The finishing room is equipped with one rewinder trimming 216 in., two trimming 122 in. and one trimming 72 in., also one 124 in. sheet cutter and one 84 in. knife cutter. Light trolleys and electrically operated hoists handle bag and other rolls coming off of the machines. The rolls of paper are transported on skids to the bag factory, storage or shipping departments. It is planned to convert approximately 250 tons of the paper produced at the mill into bags. The capacity of this department is being increased to 18,000,000 per day.

Cooking Liquor

The chemical solution used for cooking the chips in the digester is made by treating the spent liquor that has been drained out of the cooked chips so as to restore its active principals. The spent liquor is stored in seven tanks having a total capacity of 730,000 gal. and arranged for delivery either to the digesters or the evaporators. These tanks are also provided with a filter for separating any fibrous material that might be present. This liquor contains in addition to the spent inorganic compounds, which were originally active, also organic matter, dissolved out of the wood chips.

It is necessary to evaporate the water before the organic matter can be burned and the inorganic chemicals can be recovered. Liquor from the first unit is evaporated in a five-body quadruple effect evaporator, compounded in the first stage and with vapors in the last effect condensed in a barometric multiple-jet type condenser; and the evaporation of the liquor from the other two units will be done in a six-body quintuplet evaporator. The condensate from the first effect is returned to the boilers and that from the other effects into a sump pit combined with the overflow from the digester blow down condensate overflowing from the accumulator. Gases vented off in this sump pit are carried over to the recovery furnace and consumed, thus almost entirely

eliminating the obnoxious odors generally prevalent in kraft pulp mills.

The evaporators reduce the dilute solution to a very viscous solution, which is conveyed to mixing tanks where the make-up salt cake is added. It is then pumped to oscillating spray nozzles of the smelter furnaces. The furnaces are of the Tomlinson type, water tube, waste heat boilers with water cooled black ash liquor furnaces. There are three boilers for the first unit and four for the other units, all arranged for generation of steam at 450 lb. pressure at 750 deg. F. in conjunction with the power boilers. The boilers are equipped with economizers, automatic combustion control and draft regulation.

The organic matter in the liquor is burned off in the furnace and the sodium sulphate converted into the sulphide. The molten inorganic salts then flow through a spout, especially designed to reduce the noise, into a tank of water where they dissolve.

Caustic Department

From this tank the liquor is pumped to the caustic department where it is treated in a Dorr continuous system. The capacity of the equipment has been recently increased in order to meet the new demands which call for the production of 700 tons of pulp per day, at 100 cu.ft. of liquor per ton of pulp and approximately 7 lb. of total alkali per cu.ft. of liquor.

Fresh and reburned lime in measured quantities are delivered from the bins by chain feeders to an extra heavy screw conveyor, which feeds the slaker. The fresh lime coming in one end and the slaked lime passing out of the opposite end through a rotary scalping screen. The slaked lime discharges into a bowl classifier.

A part of the clear liquor to be causticized is piped into the feed end of the slaker and another portion is fed into the classifier body. Its bowl launder discharges slaked lime suspension in the liquor. This is pumped to the causticizers. They are hung in tanks with dished bottoms and flat tops with a vent pipe to the roof.

The slurry of liquor and the lime carbonate flow by gravity from the causticizers to a continuous clarifying thickener. This machine turns out clarified liquor ready for cooking the chips and an underflow of settled lime carbonate. The carbonate is washed on a filter by a hot water spray and is then ejected at about 45 per cent moisture content into a conveyor feeding a rotary kiln. Provision has been made for recovering the lime by reburning. Four 120 ft. kilns are installed; two are 8 ft. in diameter and the others are 9 ft.

A building approximately 300 ft. long and 50 ft. wide has been erected on the dock adjacent to the river from which pulp and paper can be loaded into steamers and shipped to northern ports. This building at present houses one 81 in. wet machine and a second one will be added shortly. These will produce pulp 50 per cent air dry at a combined capacity of 120 tons per day.

The production of pulp requires an enormous volume of clean water. This mill gets its supply from four 30 in. artesian wells and one 10 in. well located in various parts of the company's property. The large wells deliver from 3,000 to 4,000 gal. per min. and the small well about 800 gal. per min.

One of the most interesting features of this mill is the byproduct department which is in the process of construction at the present time. The products of this department will be sodium resinate, linoleic and oleic acids and other fats and oils. Later equipment will be added for the extraction of turpentine.

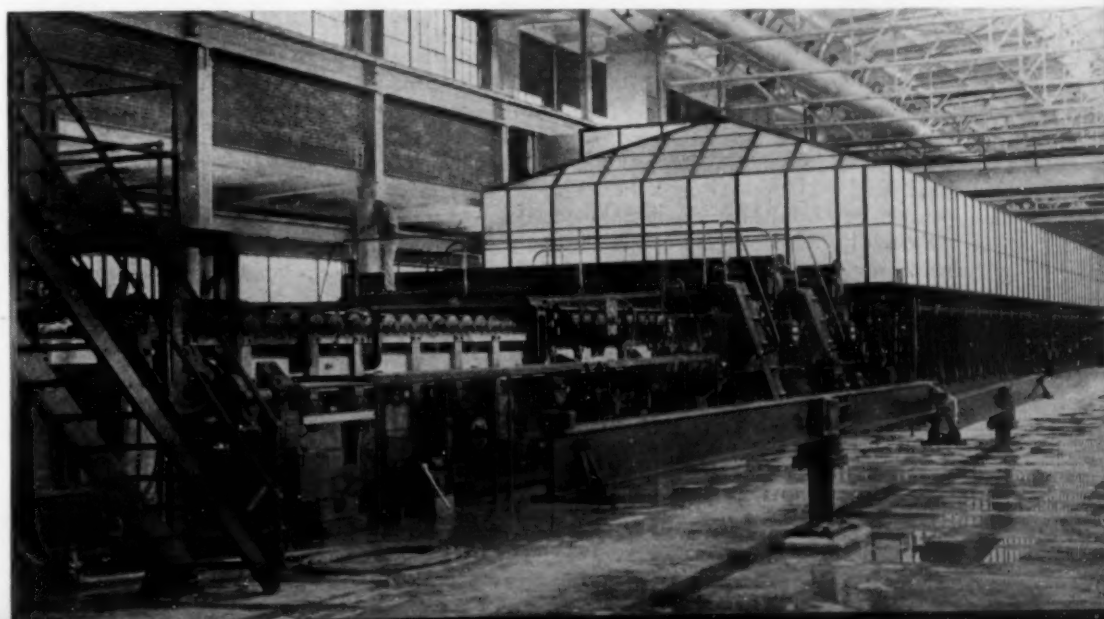
What New Paper Mills Mean to the South

The enormous pulp and paper mill that is being erected at Savannah, like the 12 or 15 other kraft mills that are under construction in the South, will have an important effect on the states south of the Mason and Dixon Line. The three units of this plant will represent an investment in real estate, buildings and equipment of approximately \$10,000,000. When the mill is completed in October, Savannah will have the largest sulphate pulp and paper mill in the world. It will give employment to 2,000 men and women at the mill and will have a payroll of about \$2,500,000 annually.

The company has several hundred thousand acres of timberland and will employ many men in the cutting and reforestation operations. In addition it has entered into contracts with the farmers in the neighborhood to supply the mill with slash pine that is growing on their own lands. This means added cash income for the farmers. There will be a market for 200,000 cords of wood for conversion into pulp, resulting in the employment of 1,000 men in the nearby pine forests. This will require expenditures of \$900,000 a year.

Also, these kraft pulp and paper mills will require enormous tonnages of salt cake, soda ash, chlorine, alum, lime and other chemicals. This newly created market already has interested one chlorine producer in constructing a plant in the deep South and other chemical manufacturers are known to be making plans for southern plants to supply the requirements of these pulp and paper mills.

One of the paper machines that produce a roll 234 in. in width



Significant Refining Developments Discussed at WORLD PETROLEUM CONGRESS

By GUSTAV EGLOFF

UNIVERSAL OIL PRODUCTS CO.
and
HONORARY VICE-PRESIDENT
SECOND WORLD PETROLEUM CONGRESS

INDICATIVE of its significance to oil men from all parts of the globe, the Second World Petroleum Congress last month (June 14-19) attracted to its 400-paper program at the Maison de la Chimie in Paris, France, over 1,600 representatives from thirty-five countries. These figures represent increases of 200 representatives and 150 papers over the first Congress, held in London in 1933. The Paris meeting was officially opened by M. Lebrun, president of France, Dr. M. L. Pineau, honorary president of the Congress, and the ten honorary vice-presidents, each representing one of the participating national committees.

The extraordinary interest shown this year was due primarily to the new processes and developments which have come to the fore since 1933 in the fields of petroleum chemistry, chemical engineering, geophysics, and oil location and drilling. Productive of the most intense discussion were the following subjects: polymerization of gaseous hydrocarbons to gasoline, lubricating oils, and synthetic rubber; 100 iso-octane motor fuels; synthetic hydrocarbon oils from water gas; sulphuric acid production from hydrogen sulphide in cracked gases; reforming of gasoline; large-size cracking units; sweetening of gasoline with copper salts; inhibitors for gasoline and lubricants; oil location by geophysical methods; and directionalized drilling for oil.

The commercial-scale polymerization of paraffin and olefin hydrocarbons to gasoline is less than four years old. On June 1 of this year there were 33 commercial units in operation or construction in different parts of the world, these having a total production capacity of 28,500 bbl. a day or 10,402,000 bbl. a year. The octane rating of the gasoline ranges between 76 and 100, but of the two polymerization processes used, the thermal and the catalytic, only the catalytic is capable of producing 100 iso-octane motor fuel. This is now being accomplished by polymerization of the butylenes, such as isobutylene present in cracked gases, and then followed by hydrogenation to iso-octane. The production of 100 octane gasoline has revolutionized not only the oil industry by making conceivable the attainment of octane values even higher than 100, but also the design of airplane engines, which, with the higher compressions now obtainable, has made the gasoline engine comparable in efficiency with the diesel engine. Barnard emphasized the value of high octane fuels in his statement that

"depending upon design and operating conditions, the revenue earning power of one gallon of gasoline may be increased from two to five cents per octane number improvement. It is evident that the earning power of octane number improvements is so great that within practical limits cost cannot influence the trend toward higher octane numbers to any appreciable extent." Iso-octane, a few years ago a rare fluid costing \$20 a gallon, is now being made in commercial plants whose combined production will soon be 6,000 bbl. per day. The fuel is being burned in airplane engines to give 15 to 30 per cent greater speed and 30 per cent greater lifting power than when 87 octane fuel is used.

The isobutylene in cracked gases is also being converted to lubricating oils in commercial units by catalytic polymerization. This synthetic lubricant is highly resistant to oxidation and sludging and has found a special use in high speed airplane engines.

By varying the conditions of catalytic polymerization of isobutylene a very viscous liquid can be obtained which is suitable for water-proofing or blending with resins, or the reaction may be so controlled as to yield a solid white crepe-like rubber, which when blended with para rubber, Thiokol or Neoprene, increases the oxidation resistance of these materials.

The Fischer-Tropsch process for converting water gas into oil is in commercial operation in Germany and France, and units are contracted for in Japan, South Africa and other countries where crude oil production is low or non-existent. The units have capacities of from 40,000 to 100,000 tons a year of an oil having a boiling range of 113 deg. F. to 702 deg. F. and a sulphur content of 0.01 per cent. Since this oil contains 56 per cent of 49 octane gasoline with a boiling point of 350 deg. F., it is unsuitable for modern motor cars and requires a reforming operation and cracking of the residue. When the oil produced from the conversion of water gas is cracked and the gas polymerized, a yield of 84 per cent of 66 octane gasoline has been obtained. It was reported that one kilogram of gas, oil and paraffin wax was obtained from 4.9 kilograms of coke. An analysis of this product showed 10 per cent hydrocarbon gas, 60 per cent gasoline fraction boiling below 392 deg. F., 22 per cent gas oil and 10 per cent paraffin wax.

The production of sulphuric acid from cracking-still gases rich in hydrogen sulphide is one of the major

recent achievements (see paper by Craise and Brown, p. 376 this issue *Chem. & Met.*) One plant is making about 85 tons of sulphuric acid per day from 13,000,000 cu.ft. of gas. Another unit is in the course of construction. The process now in operation involves the recovery of hydrogen sulphide from still gases in which it is contained to the extent of about 4½ per cent, followed by its conversion to sulphur dioxide and then to sulphur trioxide by the usual catalytic method. In addition to opening up a valuable new source of sulphuric acid, the process also has some economic and social advantages. First, the removal of hydrogen sulphide from cracking-still gases eliminates the formation of troublesome mercaptans when the olefins in the still gas are polymerized to gasoline. Second, sulphur corrosion around the refinery is cut down. Third, a public nuisance is eliminated through disposal of the oxides of sulphur in this manner rather than releasing them to the atmosphere. The hydrogen sulphide available from natural gas, cracking-still gas and refinery gas, along with the sulphur in crude oil, amounts to more than enough to produce the entire sulphuric acid needs of the nation. In France, facilities are available for making 200 tons per day of sulphuric acid from the hydrogen sulphide in hydrocarbon gases obtained from the cracking of Iraq crude oil.

The construction and operation of much larger distillation, reforming and cracking units has been aided by improvements in heat transfer, fractionation practice, and corrosion resistant alloys. Atmospheric distillation units with a capacity up to 65,000 bbl. per day are now in operation and are giving a sharp separation of gasoline, kerosene, gas oil and residue. Also in operation are reforming units for gasoline handling 15,000 bbl. per day and cracking units converting 32,000 bbl. per day of crude into 68 per cent of a 70-octane gasoline.

Marked advance has taken place in the sweetening of gasoline. Copper salts, either in solution or solid form, are now being used commercially for this purpose and are showing decided advantages over the plumbite process, which has been the conventional one for over 50 years. The advantages of copper salts over plumbite are the following: a saving of from one to three octane numbers, greater lead and inhibitor susceptibility, less copper dish gum and greater oxidation stability.

There is a notable lessening of chemical treatment of gasoline, but at the same time a greater amount of antioxidants and dyes are being used. The bulk of motor fuels in the United States is inhibited and dyed, with Europe slowly following. Inhibitors and addition compounds are used also in lubricants to an increasing extent in order to cut down oxidation and improve the film strength of the oil.

Changing Character of the Industry

The value of cracking as a means of conservation of crude oil supplies becomes increasingly significant as the process is improved. Last year 786,000,000 bbl. of crude oil were cracked to obtain 303,452,000 bbl. of high anti-knock gasoline, thus conserving approximately 1,865,000,000 bbl. of crude. Without cracking, it would have required 3,607,000,000 bbl. of crude, instead of the actual 1,742,000,000 bbl. refined, to supply gasoline for propelling the world's motor vehicles in 1936. Although small in comparison with these quantities, the 10,000,000 bbl. of polymer gasoline produced last year meant a conservation of over 70,000,000 bbl. of crude. With

development of the polymerization process proceeding at the remarkable pace it has for the past two years, polymer gasoline will continue to account for much larger proportions of world production.

The physical and economic structure of the oil industry has also been greatly affected by the cracking process. It would have been necessary to locate more oil fields, expand storage facilities, pipelines and refining capacity if those extra 1,865,000,000 bbl. of crude had had to be handled to supply the gasoline needs of the world in 1936. Instead of this, however, \$500,000,000 has been invested in new equipment for cracking and polymerization.

Cracking has found an additional usefulness in modern refineries as a "means for adjusting the yields of various products of petroleum to meet the ever-changing demands of the market," quoting Colonel Auld, president of the Institute of Petroleum Technologists. The cracking process produces cracked gasoline, polymer gasoline, iso-octane, fuel oil, coke, gas, and other products. It also supplies the starting materials for making antioxidants, color inhibitors, dyes, resins, rubber substitutes, ethers, glycols, alcohols, acids, aldehydes, pickling agents, acetylene, and sulphuric acid. Not unworthy of mention is the fact that it has been the stimulus behind much of the recent progress in metallurgical and ceramic fields.

Developments in Locating and Drilling

The physicists, mathematicians, chemists and engineers have profoundly affected the methods of locating and drilling for oil in the past few years. New oil fields have been discovered by use of the seismograph, torsion balance, radio, and airplane photography. Colloidal clays to balance wall pressure, cement for closing off water layers, chemical agents to react with the water sands to seal off the water, acidification of wells to increase their flow, and new alloys for drilling bits are all recent contributions of the chemist.

For a long time the oil industry has been cursed with the inability to drill a straight hole in the ground. Frequently, the end of the bit would drift over a quarter of a mile from the vertical, whereas today it is possible to drill a well which at the end of over two miles is within two degrees of the vertical. A well can now be drilled in any direction and the bottom of the well placed within a 9-ft. circle. From a single drilling rig, one well has been explored for oil in eight different directions. This directionalized drilling is of extreme importance, not only in locating oil, but also as a means of combating oil-well fires. In case of a fire a second well is drilled nearby at an angle so that the end strikes into the oil sand which is feeding the fire. Through this second well, water is pumped into the sand and out goes the fire.

The sessions of the Second Congress closed with a banquet at Versailles on June 19. Prior to this there was appointed a permanent Council for future World Petroleum Congresses, the members of which are: Col. S.J.M. Auld, Great Britain; J.H.C. de Brey, Netherlands; Charles Bihoreau, France; Gustav Egloff, United States; L. Mrazec, Roumania; S. Pilat, Poland; M. Streintz, Austria; H. Suida, Austria; M. Dewhurst, Great Britain; L. Ubbelohde, Germany; H. Weiss, France; and S. Scheer, France. The Third Congress will be held in 1940. Its location is yet indefinite.

Eldorado camp on Great Bear Lake—on the rim of the Arctic Circle, 2,000 miles north of Edmonton. Here radium bearing pitchblende is mined and transported by air, rail, and water to Port Hope

RADIUM RECOVERY

Canada's Unique Chemical Industry



By MARCEL POCHON

DIRECTOR AND CHIEF CHEMICAL ENGINEER,
ELDORADO GOLD MINES, LTD.,
PORT HOPE, ONT.

SINCE the discovery of radium, many extraction plants have been erected and operated at various times in several countries of the world, yet their chemical processes, in essential part, closely follow the procedure first used by the Curies in 1898. The treatment at Port Hope of the Great Bear Lake pitchblende is not essentially different for it is also based on these same general principles.

Recovery of radium from any uranium mineral requires two stages in the process. In the first stage the ore is treated in the chemical plant to separate out the uranium and to concentrate the radium in the form of a barium radium sulphate. Since radium and barium have the same chemical properties, the minute quantities of radium are occluded and carried by the barium throughout the operations. If barium is not present in the ore, some must be added at the start. The second stage consists of a laboratory treatment of the concentrate to separate the barium from the radium, and to produce finally the radium salt (chloride or bromide), at a minimum concentration of 90 per cent.

The radium industry has always used the Curie method of laboratory treatment, which is still the only practical means of separating radium from barium. But the

methods and equipment used in the first stage have varied considerably, for every plant has had to adopt a reduction process most suitable to the type and composition of the mineral available.

Pitchblende and metallic silver are found strongly associated in the vein system of the Great Bear Lake deposits of Northern Canada. A mechanical concentration is effected at the mine, delivering to Port Hope four types of products, each different in content and chemical structure: (1) A hand-picked lump ore, (2) A $\frac{1}{4}$ in. jig concentrate, (3) A 14-mesh Wilfley concentrate and (4) A finer Deister concentrate. The presence of a valuable amount of silver mixed with the pitchblende presented the plant with a special problem, because it was imperative to have a single process of treatment efficient for both silver and radium recovery and suitable to all types of ore produced at the mine. A great deal of experimental work had to be done before a definite method could be adopted.

Chemical operations were commenced at Port Hope in January, 1933, following a procedure already investigated in the Canadian Mines Branch at Ottawa. At first it was thought advisable to remove the radium, letting the silver accumulate in the residues, finally to be recovered by smelting. Some difficulties were experienced, however, due to the large amount of silver hindering the filtering operation, and after three years of

Based on a paper presented before the American Institute of Chemical Engineers, at Toronto, Ontario, May 25, 1937.

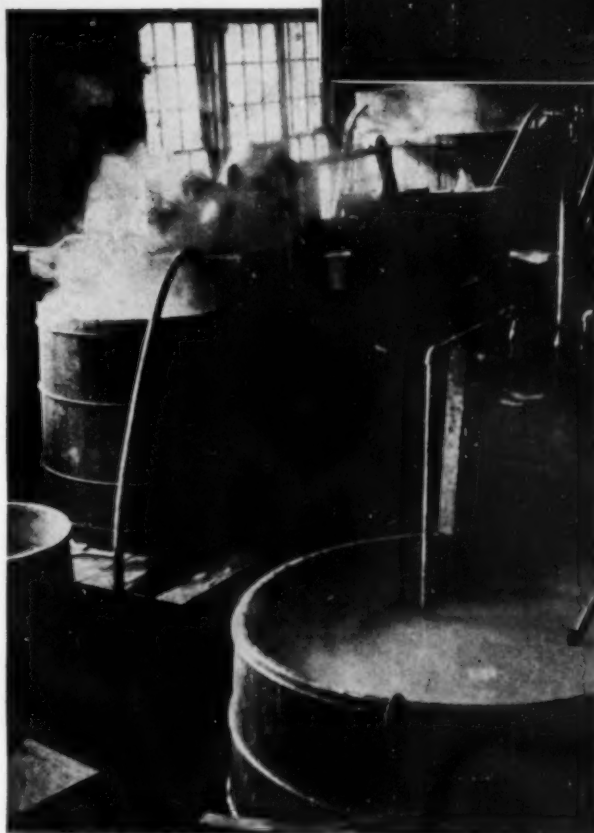


At right: The concentrated pitchblende ore is leached with sulphuric acid in stoneware vessels to remove the uranium and other soluble compounds

Below: Refining sodium uranate in the radium extraction plant. Production of uranium products is currently about 12 tons monthly



At left: The author, Dr. Marcel Pochon



experimenting, another process was developed in 1935, again with the collaboration of the Mines Branch. This process is now in constant operation at the plant, and provides for the removal of the silver early in the work, followed by the recovering of the radium. Treatment of 150 tons of pitchblende, with 1550 ounces of silver per ton, was successfully completed in 1936, giving evidence that the process was efficient and economical.

The process consists of four different operations, which are housed in separate buildings at Port Hope. These are: (1) The preparation of the minerals by roasting and milling, (2) The recovery of silver, and the reduction of the radium into radium-barium sulphate, (3) Finishing of the radium in the laboratory, and (4) Refining of the uranium salts.

Roasting and Milling the Minerals

Since the pitchblende concentrate received at Port Hope from the Great Bear mill is the product of a gravity, water-classification process, it contains, in addition to the uranium and silver, other heavy metals as impurities. These are mostly arsenopyrite, chalcopyrite, galena, cobalt and bismuth minerals. Also present are some of the gangue materials, like quartz, hematite, barite, calcium and manganese carbonates. The pitchblende is by far the most abundant mineral. The concentrate contains from 35 per cent to 50 per cent of oxide of uranium and from one to seven per cent of silver, according to the section of the mine from which the ores are taken.

In the first stage of the wet processing of this ore, a

strong sulphuric acid treatment is used. Since the sulphides and carbonates cause much gassing and foaming, it was found necessary to give the ore a preliminary roasting.

The hand-cobbed ore is first crushed in a rock-breaker to about $\frac{1}{4}$ in. mesh, mixed with the finer classified ore, and fed to a Herreshoff furnace, mechanically rabbled and kept at about 1100 deg. F. while a good blast of air is maintained into the furnace. This decomposes the

sulphides and carbonates, and eliminates by volatilization some arsenic and antimony. The operation is continuous, with a circulation of about 110 lb. of ore per hour. A dust collector is attached to the stack of the furnace, and recovers about 50 lb. of fine dust per 24 hours.

Since the silver is present mostly as native silver, the usual method of wet extraction by a solution of sodium cyanide or hyposulphite is not suitable. To make it extractible, the ore is re-roasted with salt to transform the silver and uranium into chlorides. The salt is mixed with the product of the oxidizing roast in proportion to its silver content. In practice 5 per cent to 10 per cent is used, and the salt roasting is done in a reverberatory furnace, hand rabbled, taking four hours for a charge of about 350 lb. The temperature is kept as low as possible to avoid losses of silver chloride as a result of volatilization.

The chloridized product, after discharge from the furnace, is allowed to cool and is ground in a rod mill, passed through a 40-mesh screen, and bagged. It is now ready for the wet process. The 40-mesh size is sufficiently fine for a good contact with the chemicals, and coarse enough for the filtration during the following steps. Each 100 lb. of raw ore gives about 97 lb. of roasted product from the Herreshoff furnace, and about 104 lb. of ground ore after the salt roast.

The roasting and milling operations are carried on continuously for every car of 40 tons received from the mine. The furnaces are then shut down for a day or two for cleaning up and repairs.

Sampling is done on every batch of five tons of ground ore. A liberal sample is taken to permit complete assay and other laboratory tests of the various operations of the process which will be followed three to four weeks later when that particular batch is subjected to treatment in the plant.

Silver Recovery and Radium Reduction

The first step in this series of operations is leaching with sulphuric acid, followed by filtration. About 420 lb. of ore are leached for six hours in a stoneware leacher using sulphuric acid, diluted one for one with water. The ore contains only about 0.5 per cent of barium sulphate, which is scarcely sufficient to act as a carrier for the radium. An equal quantity of barium chloride is therefore added during the leach. During the second hour about 5 per cent of sodium nitrate is also added in order to oxidize the uranium solution. At the end of this operation, a few pounds of hydrochloric acid are added to take care of any soluble silver. After filtration in a stoneware suction filter, an insoluble residue is separated and a filtrate of crude uranium sulphate is obtained, containing as impurities iron, copper, manganese, calcium and some other soluble metallic compounds. This filtrate is transferred to the uranium refinery.

The insoluble sulphate residue contains the radium, barium, silver, lead, silica, and some calcium. It is assayed for silver, then agitated in a steel revolving drum for three hours with the necessary quantity of sodium hyposulphite. After filtration and washing in a suction filter, the insoluble residues are extracted, and the filtrate of silver liquor is precipitated with sodium sulphide. The silver sulphide is passed through a filter press, dried, ground, and shipped to silver refineries in the United States. This silver sulphide contains an

average of from 75 per cent to 80 per cent of silver metal, with a small amount of impurities such as iron, lead, bismuth arsenic and antimony.

The residues from this hypo leaching usually contain from 12 per cent to 18 per cent of lead sulphate, and they are now treated for the extraction of the lead. This is done by boiling in an open steel kettle for 1½ hours with caustic soda, and filtering first in a filter press and then completing the washing of the insolubles in a battery of pressure filters. The lead eliminated in the solution is not recovered commercially. About 98 per cent to 99 per cent of the lead is removed, and also a certain amount of silica.

The insoluble residue now contains silica, radium and barium. It is boiled with soda ash in a steam-jacketed autoclave for six hours under low pressure. The carbonated material is filtered, and the washing of the cakes finished in a battery of pressure filters. The cakes are placed in stoneware kettles, acidified with a strong solution of hydrochloric acid and boiled. Filtration on stoneware suction filters follows, resulting in a residue of silica containing too little radium to be of practical interest, and a filtrate consisting of the barium and the radium-chlorides.

This chloride liquor is pumped to a set of stoneware precipitators, which are agitated with a slight excess of sulphuric acid for six hours. After settling, the sulphate concentrate is drawn off, filtered, and washed. It is then delivered to the finishing laboratory for further treatment. The precipitate is composed mostly of radium and barium sulphates and carries some impurities of lead, calcium, iron and silica. The quantity of radium-barium concentrate produced is about 1.5 per cent of the weight of the original ore treated, giving a reduction ratio of about one ton of sulphate for sixty-six tons of ore.

For each 100 lb. of ore treated, the weights of the various insoluble residues obtained during the series of operations are as follows: After sulphuric leaching, 35-40 lb.; after hypo leaching, 30-35 lb.; after caustic soda leaching, 20-25 lb.; and after soda ash and muriatic acid, 10-20 lb. Some high grade silver and pitchblende ore treated at the plant has left the final residue amounting to only 6 per cent.

The processing equipment used in these stages at Port Hope is simply large size laboratory units. The extremely high content of radium in the ore requires that only small lots be handled at one time, and recovery and washing must be unusually complete. The final residues are maintained at about three milligrams of radium per ton, and about 25 ounces of silver, and their re-treatment is no longer economical or practical. The percentage of recovery for the silver is above 95 per cent, and over 90 per cent for the radium. The finishing of the radium proceeds as follows:

The radium-barium sulphate concentrates are transferred from the plant to the laboratory, where they are changed to carbonates by boiling with soda ash in steel kettles. After filtration and washing, the carbonates are acidified with hydrobromic acid, and the bromide liquors are purified for removal of the lead, iron, copper, etc., using barium hydroxide and barium sulphide as purifying agents. All impurities and insoluble residues are collected, and when a certain quantity has accumulated, they are treated again with sulphuric acid, soda ash and hydrobromic acid, and the purified solution added to the bromide liquor already available. The final residue



Here is the final product: Commercial radium, 100 mg. of radium in radium-barium bromide, sealed in a glass tube the size of a match and worth approximately \$2,500 at the present Canadian price

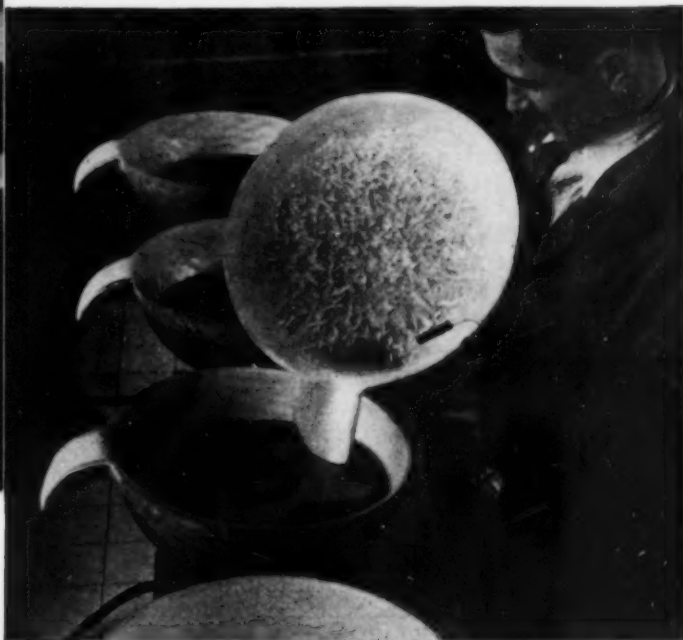


still contains a little radium; it is therefore, sent back to the leachers at the beginning of the wet process.

Separation of the radium from the barium is effected by fractional crystallization, using the differential solubility of the radium and barium bromides in water. The purified bromide liquors are evaporated to saturation and allowed to cool. A crop of crystals comes out in the bottom, richer in radium and poorer in barium than the liquor above it. The operation is repeated separately on the crystals and on the solution in a system of quartz basins and Monel metal pails to insure an even flow of successively richer and richer radium bromide in the crystals, and poorer and poorer barium bromide in the liquors. The initial bromide solution has a ratio of about one part radium to 400,000 parts of barium. The head crystals, after ten crystallizations, show one part of radium to about 600 of barium. These crystals are separated from the system, and accumulated for about one month. They are then re-purified in the same way as the original liquor and the crystallization is carried to a point where the ratio is nine parts of radium to one of barium. The crystals are then dried, transferred into glass tubes and sealed therein by a blowtorch.

Picking the needle from the haystack!

The starting liquor for the final fractionation contains approximately 400,000 parts of barium to one of radium. After 23 different evaporation and crystallization processes, commercial radium bromide containing 9 parts of radium to 1 part of barium bromide is finally produced



Evaporation in Monel metal pails is followed by fractional crystallizations in fused silica dishes

The filtrate from the acid solution of the ore (first stage in the wet processing of the roasted ore) is pumped to a separate building for the refining of the uranium. This liquor is treated with an excess of sodium carbonate which dissolves the uranium as sodium uranyl carbonate and precipitates the iron, manganese and most of the copper. The sodium uranyl carbonate liquor, after settling, is decanted to other tanks and decomposed with sulphuric acid. Caustic soda is added to this to precipitate a crude sodium uranate. This crude product is removed in filter presses, dissolved in sulphuric acid and small impurities precipitated by additions of sodium sulphide. The clear filtrate from this operation is freed of hydrogen sulphide and sulphur, and sodium hydroxide is added to precipitate the orange or yellow sodium uranate of commerce. This product is washed, pressed, dried and ground, bagged and shipped to the consumer. The difference in color between the orange and the yellow products is due to the different amounts of caustic soda used for the precipitation, the orange requiring an excess of caustic.

Black oxide of uranium is made by dissolving purified sodium uranate liquor and precipitating with ammonium hydroxide, washing, drying, and burning in crucibles in an electric furnace. Ammonia is driven off, and a reduction of the material effected to give the desired compound. Uranium nitrate is made by solution of the oxide in nitric acid, and crystallization of the product from water in large porcelain trays. Uranium acetate is made by solution of the hydrate in acetic acid, and recrystallization from water.

Ammonium Sulphate Crystallization Benefits From Simple Inexpensive Process

By G. BERKHOFF

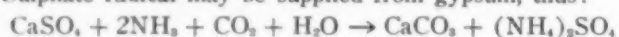
STIKSTOFBINDINGSBEDRIJF
LUTTERADE, HOLLAND

Whether the process described in this article is suited to American conditions is not entirely certain. It has, however, attracted much attention in Europe in the past two or three years and has been installed in plants in three countries, having a total annual capacity of 465,000 long tons of ammonium sulphate. Dr. Berkhoff's interesting article is the first description of the process to appear in an English language periodical.—Editor.

DURING RECENT YEARS overproduction of nitrogen compounds in Europe has forced producers to pay particular attention to the physical properties and appearance of their products. Especially has this been the case among those producers of ammonium sulphate who use sulphuric acid as the source of sulphate radical, for it has become apparent that the gypsum process employed in the most important works (namely, the I. G. Farbenindustrie at Leuna and Oppau, the Office National Industrie de l'Azote at Toulouse and the I. C. I. at Billingham) inherently yields an attractive coarse crystalline shape of product. Such a crystal has important advantages not only for the producer but for the user as well. A coarse crystalline product is simpler and less expensive to produce than a fine dusty salt. In use, it spreads more readily, has less tendency to cake in storage and blows away to a lesser extent when spread.

Consequently, in order to keep pace with the leading producers, nearly all European works engaged in ammonium sulphate manufacture have spent much time and effort in an endeavor to produce an equally good crystalline form. One of the resulting processes is that in use by De Staatsmijnen in Limburg, Lutterade, Holland. The process has the advantage of extreme simplicity and involves no added expense over that incurred in less satisfactory methods. To the date of writing it has been licensed to the extent of 40,000 long tons annual capacity in Belgium and 150,000 long tons in Japan, while the installed capacity at the Lutterade plant in Holland is 275,000 long tons annually. The product possesses the several advantages enumerated above, occurring as beautiful large crystals nearly square in shape. Screen analysis shows that 77.5 per cent of the crystals are larger than 0.5 mm., while 98 per cent remain on a 0.2 mm. screen.

Ammonium sulphate is made in a number of different ways, the results differing with the various raw materials that may be used, owing, it has been found, to the presence or absence of certain impurities in the raw materials. Sulphate radical may be supplied from gypsum, thus:



Much more frequently, however, sulphuric acid is the acidulating agent, and this acid may be produced by either the chamber or the contact process, from either brimstone or pyrites. How the acid is made determines what impurities it contains and what effect they will have on the resulting crystals. Similarly, the ammonia used may be either synthetic or from coke ovens, and here again variable impurity content will have its effect on the product.

Until a dozen years ago, outside the sugar industry, very little study had been devoted to the subject of crystallization. Since then, however, interest in the problem has increased enormously and much attention has been paid to it in the technical literature. While the recent findings cannot be detailed here, it should be pointed out that much has been discovered in regard both to the physical and the chemical effects of the environment upon the formation of crystals.

Control of the crystallization of ammonium sulphate, as it has been finally worked out, has been found to fall into two classifications: control of the physical conditions, and of the chemical conditions of the saturator contents. The optimum physical conditions may be summarized as:

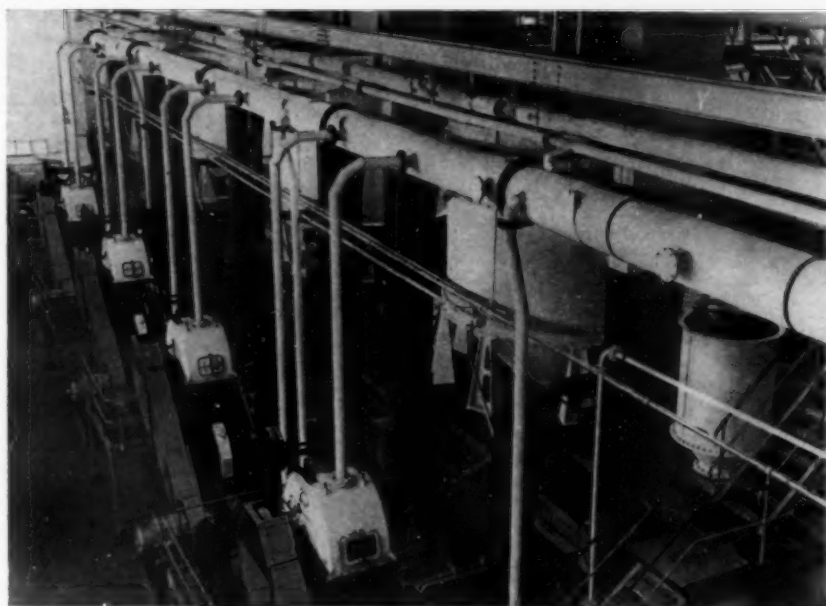
1. Keeping the whole bath homogeneous with respect to the crystal suspension, the degree of supersaturation of the solution and the acidity of the solution. Homogeneity can be promoted by keeping the bath in regular circulation, as by blowing in gas at the bottom of the saturator, or by stirring apparatus. Proper shaping of the ammonia distribution system is important, as is suitable design of the saturator. When synthetic ammonia is used, its volume is advantageously increased by dilution with an inert gas such as steam or air, and the gas stream introduced at high velocity by use of increased pressure. Any combination of these several methods will assist in attaining the desired end, while at the same time the capacity of the saturator will be increased.

2. Maintaining a predetermined constant degree of acidity in the bath by careful adjustment of the rate of acid and ammonia feed, which requires frequent check of the saturator acidity.

3. Keeping constant the optimum total crystal surface in the bath, by regulating the admission of acid and ammonia with respect to the rate of withdrawal of finished crystals.

4. Preventing or undoing the local production of unwanted crystal nuclei through the use of refrigeration.

Attention to the factors enumerated above will assist in producing suitable crystals, but it has been found that when certain impurities are present in the bath, still other control must be exerted. This is particularly the case



Saturators and horizontal centrifugals in the ammonium sulphate department of the Lutterade plant, De Staatsmijnen in Limburg, Holland

when synthetic ammonia is used, together with chamber acid. Impurities contained in the latter generally include arsenic, iron compounds, aluminum compounds and nitrogen oxides.

It has been found that neither the arsenic nor the nitrogen oxides (the latter being largely lost when the acid is diluted with the mother liquor) play an important part in the crystallization of ammonium sulphate. Iron and aluminum compounds, however, have a decided effect. It has been well known for some time that the presence of a steadily increasing percentage of ferrous salts in the saturator results in the production of drawn-out crystals of ammonium sulphate, which accounts for the fact that sulphate produced from coke oven ammonia is always needle shaped. It has also been known that when ferric, aluminum or chromium salts are present, no proper crystallization can be accomplished at all. With byproduct ammonia, the iron compounds are in contact with reducing substances and the iron is in the ferrous condition, but with synthetic ammonia the iron remains ferric and hence it is easier to produce a satisfactory crystallization with the byproduct than with the synthetic material.

These facts have been checked by our own experience. Moreover, we have found that with these trivalent ions present, a steadily increasing acid percentage is necessary in the saturator in producing a satisfactory product. But eventually, when the acidity of the mother liquor has attained 4-6 per cent, we have found that a brown discoloration or even a flocculent brown precipitate forms, which is an iron-aluminum-arsenic containing colloidal complex. The presence of this colloid disturbs the crystallization to an even greater extent than the same quantities of these agents in crystalloidal solution.

Experiment has shown that an increasing acidity is necessary to keep the impurities, as they increase in the bath, in solution. But this same increase in acidity promotes the formation of smaller crystals and at the same time hastens the corrosion of the saturator.

Various processes, of varying degrees of complexity,

have been put forth to deal with this situation. In the main these attempt to remove the iron or to leave it in the reduced condition, but are not concerned with either the aluminum or the chromium. The latter may be present to a considerable extent when chrome nickel steels are used for saturators, centrifugals and the like (with synthetic ammonia—for such steels are not applicable when reducing substances are present, as with coke oven ammonia).

An ideally simple process has been worked out at the nitrogen fixation plant of De Staatsmijnen, whereby through the addition of phosphoric acid or phosphates to the bath liquor, practically all of the ferric, aluminum and chromium ions are eliminated at the working temperature, by precipitation in a form which does not interfere with the production of coarse ammonium sulphate crystals. The process, patented in various countries (patent applied for in U. S. A.), is extremely simple. All that is necessary is to add sufficient phosphoric

acid or soluble phosphate to the bath liquor to correspond to the trivalent ion content, at the same time adjusting the acidity to a percentage preferably below 1.5. The precipitate is removed with the crystals and a moderate excess of phosphate has no adverse effect. Whereas a well operated saturator not using this process would require an acidity of say 6 per cent to keep the impurities in solution and would produce crystals having a ratio of length to width of 10:1, with about 75 per cent larger than 0.2 mm., the addition of a relatively small percentage of 14 per cent superphosphate, with an acidity in the saturator of $\frac{1}{2}$ -1 per cent, would decrease the ferric iron content of the mother liquor to unimportant proportions, and produce crystals having a length-to-width ratio of 1.5:1, 98 per cent of which were larger than 0.2 mm. This is a decided improvement in both shape and size.

Aside from the improvement in the product, we have found that the new process offers important operating advantages. Owing to the much lower acidity, saturator life is at least doubled. Where formerly shut downs were required to remove incrustations every fourth day, this is no longer necessary and more uniform operation and greater capacity results. The coarser salt is much easier to centrifuge, and the rotation speed of the centrifugals has been materially decreased, with substantial reduction in their maintenance. The lower acid content of the salt has increased the life of the materials handling equipment, and the fact that it contains less moisture and is in better form has made possible the use of a simple dryer without moving parts. No neutralization of the salt is required, nor any crushing and screening after drying. Considering the fact that the precipitated impurities go off with the product, becoming part of it, and that hence the added superphosphate means no added expense, the many advantages of the process are evident. Better crystal form, lower power and maintenance costs, easier operation and larger production from the same equipment, all combine to make the process one that merits serious consideration.



Construction views of a new
sludge conversion plant

Modified Acid Recovery Process Treats Troublesome Acid Sludges

By S. F. SPANGLER

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FROM THE commencement of use of sulphuric acid in the refining of petroleum, the problem of recovering the acid present in the acid sludge so produced has received considerable study with the dual objects of reducing treating costs and avoiding disposal problems. For years the accepted method has involved the separation or hydrolysis of the acid sludge into weak or separated sludge acid and hydrocarbons and the subsequent concentration of the weak acid to a strength suitable for reuse in treating.

During the decade of 1920 to 1930, progress in oil refining resulted in the production of cracked distillates requiring treatment by stronger acid and giving acid sludges more difficult to separate than those formerly produced. In some cases acid sludges were produced that could not be economically hydrolyzed by any known process, necessitating their disposal without recovery of acid content. Concentrating processes, though greatly improved during that decade, failed to produce the higher strengths of acid required from the more contaminated sludge acids available.

Since it had long been known that acid sludge decomposed slowly with liberation of sulphur dioxide gas—a basic material for the production of sulphuric acid—many inventors proposed to accelerate this reaction by

heat with the object of obtaining the sulphur dioxide of the strength and purity necessary for economical production of sulphuric acid. None of these proposals resulted in a commercially acceptable process until 1931.

The process then developed by the late I. Hechenbleikner (then vice-president of the Chemical Construction Corp., New York) has been described in detail elsewhere^{1, 2}. It was first installed on a commercial scale in 1932 under the name of "Chemico" sludge conversion process at the works of W. P. Daugherty & Sons Refining Co., (now the Daugherty Refining Division of L. Sonneborn Sons, Inc.) at Petrolia, Pa. Briefly, it involved: (1) the continuous thermal decomposition of acid sludge into sulphur dioxide and coke in a rotary kiln by means of hot combustion gases produced in a separate furnace and introduced directly into the interior of the rotary kiln; (2) purification of the sulphur dioxide gas; and (3) conversion of the sulphur dioxide gas into acid in a contact sulphuric acid plant using vanadium catalyst.

This first large plant naturally encountered some difficulties which required changes in certain pieces of its equipment before operations became entirely satisfactory. These changes, however, did not extend to any of the basic features of the process. The operations did, however, disclose that some basic changes would be necessary when processing certain types of acid sludges which were not among the types produced at Petrolia.

Based on a paper presented before the Refining Division, Second World Petroleum Congress, Paris, France, June 14-19, 1937, under the original title, "Recent Progress in Refinery Acid Recovery."

The principal difficulties arose from the necessity of purifying the sulphur dioxide gas before introducing it into the contact acid plant. The gases leaving the rotary decomposing kiln consist primarily of sulphur dioxide diluted with combustion gases and water vapor, but they also contain both condensable and fixed hydrocarbons in varying quantities, depending upon the character of the acid sludge.

The process of gas purification found most suitable and used at Petrolia employs the following steps:

1. Condensation of excess water and condensable hydrocarbons by passing the gas through spray towers and scrubbers.
2. Oxidation of the non-condensable fixed hydrocarbons by passing the gas through a secondary combustion furnace heated by an oil burner.
3. Cooling of the gases leaving the secondary furnace by passage through additional scrubbers.
4. Removal of traces of acid mist, formed at the high temperature prevailing in the secondary furnace, by passage of the gas through a Cottrell electric mist precipitator.

The subsequent drying of the gas by passage through a tower over which strong acid is circulated is regarded as part of the contact acid process rather than as part of the purification system, since such drying is the usual procedure in manufacturing sulphuric acid by the contact process.

The sludges handled at Petrolia were largely produced in the treatment of medicinal oils and upon decomposition produced relatively small amounts of hydrocarbons. In order to compare and predict the behavior of various acid sludges when treated by this process, it was early found necessary to devise an empirical method of sludge analysis. The method eventually adopted as standard, in its essentials comprises decomposing a definite amount of sludge by heating in a closed flask under definite conditions and measuring the quantities of water, sulphur

dioxide, condensable hydrocarbons and uncondensable hydrocarbons evolved and the quantity of coke remaining. These quantities are expressed as percentages of the sludge decomposed. This procedure obviously is not an exact analysis of the composition of the sludge but rather yields a determination of its products of decomposition.

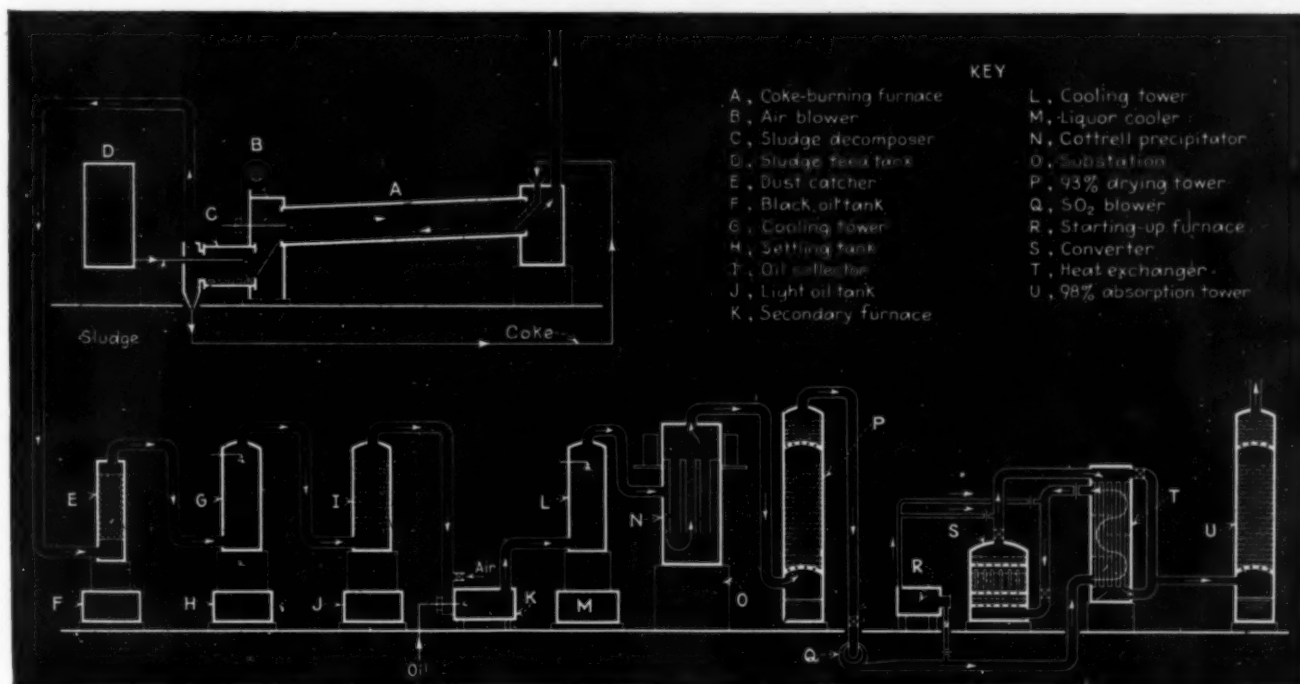
An average sludge of the type handled in the Petrolia plant showed the following results by this method of analysis:

	Per Cent
Sulphur dioxide	37.7
Total water	21.0
Condensable hydrocarbons	1.8
Uncondensable hydrocarbons	0.2
Coke	39.0

With such sludges the gases leaving the kiln contain 15 to 25 per cent by volume of sulphur dioxide. It is essential for satisfactory and economical acid production that the gases entering the contact acid unit of the plant contain 7 to 8 per cent of sulphur dioxide and approximately 1.4 times as much oxygen as sulphur dioxide. Adjustment of the gas composition to these figures was feasible with sludges of the type used at Petrolia.

Many acid sludges produced at oil refineries yield on decomposition hydrocarbons in much larger quantities than stated above. Stagner^a has reported analyses of gasoline sludges yielding 10 per cent of oil (condensable hydrocarbons) on decomposition. Investigations and tests by the Chemical Construction Corp. soon indicated that average sludges produced in American refineries yielded around 5 to 6 per cent of condensable hydrocarbons and 0.5 to 1 per cent of fixed hydrocarbons rather than much smaller quantities encountered at Petrolia. It was found that these larger quantities of hydrocarbons could not be removed from gases containing only 20 per cent of SO₂ without reducing the strength of the gas entering the contact acid unit below the required value, be-

Typical flow diagram of Chemico sludge conversion plant for the recovery of concentrated sulphuric acid from acid sludges



cause of the greater quantity of air which had to be introduced into the secondary furnace.

This problem was attacked from several different angles. The first efforts were directed to removing part of the hydrocarbons by preheating the sludge before its introduction into the decomposing kiln⁴. This procedure, while theoretically attractive, introduced many mechanical difficulties which increased the cost of the plant. Purification of the kiln gases by absorption and subsequent distillation or stripping of the sulphur dioxide was also investigated but this proved uneconomical because of the relatively large volumes to be handled with gas containing initially only 20 per cent of sulphur dioxide. The problem was eventually solved by the development of a method of producing a stronger gas in the decomposing kiln.

Decomposing With Hot Solids

It has been pointed out that the sludge in the Petrolia plant is decomposed by direct contact with combustion gases which remain in the gases leaving the kiln and reduce the percentage content of sulphur dioxide. Serious mechanical difficulties attended all attempts to decompose the sludge by externally heating either a kiln or retort. After extensive experimentation in the laboratories and pilot plant of the Chemical Construction Corp., a satisfactory method of decomposing the sludge by direct contact with inert heated solids was developed.

Initially it was proposed to heat inert solids, such as iron balls or sand, in a separate furnace and then introduce the hot solids into a decomposing vessel containing the sludge. For continuous operation, both heating furnace and decomposing vessel were made in the form of rotary kilns. Since the solids, after transmitting their heat to the sludge and causing its decomposition, would necessarily leave the decomposing kiln mixed with the coke residue from the sludge, the solids could best be reheated by combustion of the admixed coke in the heating kiln. However, most sludges produced more coke than was required for heating the inert solids and this raised the problem of separating the excess coke from the solids before the mixture entered the heating kiln.

This problem was solved by the discovery that the coke itself was in a form satisfactorily utilizable as the inert solid. It was found merely necessary to burn sufficient coke in the heating kiln to heat the rest of the coke to the required degree and then introduce this heated coke into the decomposing kiln for the decomposition of the acid sludge. The decomposition produces more coke which, along with that previously introduced into the decomposer, passes out of the decomposer for reintroduction into the heating kiln in a continuous cycle. With most sludges the quantity of coke in the cycle would increase; so the surplus is withdrawn continuously for use elsewhere as a byproduct fuel. In the case of the few sludges that do not yield enough coke for thus carrying out this process, the deficiency is made up by using an auxiliary source of heat, such as an oil burner, in the heating kiln and in extreme cases by keeping a quantity of sand in circulation as an additional inert solid.

By this procedure, with the decomposition effected in a relatively small closed rotary kiln, there was no dilution of the gaseous products of decomposition except to a small extent by infiltration of air. As a consequence,

gases containing as much as 80 per cent by volume of sulphur dioxide were obtained from the decomposing kiln of the semi-commercial experimental plant. Purification of such gases by the methods employed at the Petrolia plant could readily be effected without reducing the concentration of the sulphur dioxide below that required for conversion into acid.

This modified process, on which patents have been secured in the United States^{5,6} and other principal oil refining countries, was thoroughly tested on a semi-commercial scale with many types of acid sludge before it was offered to the refining industry. Unfortunately for the promoters of the process, its offering was thus delayed so that it occurred in the midst of the recent business depression when new refinery construction was being held to a minimum. Also at that time many refineries believed that the consumption of sulphuric acid would soon be greatly reduced, and in some cases eliminated, by use of solvent treating of oils. As a consequence, there were no immediate commercial installations of the modified process, although the technical staffs of several leading refineries regularly gave it attentive study.

During this period the Petrolia plant continued to operate regularly with a commercial success that astonished those critics who had predicted failure on the basis of the difficulties attending its initial operation. Built originally to produce 50 tons per day of fuming sulphuric acid, the plant actually produced an average per calendar day of over 51.5 tons during 1935 and of over 52 tons during 1936, with exceptionally high yields. This acid was produced at an operating expense differing only in very minor items from the expense originally estimated, with resulting attractive profits to both its purchaser and builder, who continued supervision of its operations on behalf of the purchaser under a profit-sharing contract.

During 1935 several refineries, recognizing a resumption of demand for sulphuric acid for treating and a prospective rise in its price on account of generally improved business conditions, investigated in the most thorough manner the technical features of the modified process and the results of operations at Petrolia. As a consequence of these investigations, installations of large commercial plants employing the modified "Chemico" sludge conversion process, using coke as the heating medium, were authorized by three different refining companies.

Two of these new installations are located in the United States, the other in the West Indies. All three plants are now under construction; the first two will be ready for initial operation by early summer of 1937 and the third a few months later. It is unfortunate that the results of these operations will not be available in time for presentation as part of this paper, but all concerned with the installations are confident of success in view of the results obtained with the pilot plant and at Petrolia.

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Chemical Engineering Problems In Refining of Platinum

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CHEMICAL ENGINEERING PROBLEMS in connection with the refining of platinum are of a specialized nature, with the result that experience in other fields is not always directly applicable. Moreover, the tradition of secrecy in the platinum industry up to the present has prevented refiners from pooling their experience except in a very general way. The state of affairs is in marked contrast with what is known about the plant and processes for the refining of silver and gold.

These remarks are not intended to apply to smelting operations, which have received adequate treatment in text-books on metallurgy, but rather to the wet processes for refining crude platinum and platinum concentrates.

The very nobility of the platinum metals necessitates the use of powerful acids and other reagents for refining them, a circumstance which rules out many of the standard materials for the construction of chemical plant; for instance, even stainless steel can rarely be used. The scale of operations is small, even the refining of platinum is frequently described as large scale laboratory work and the refining of other metals of the group is on a smaller scale still. Mechanical operations are reduced to a minimum, and where machines have to be used the simpler they are the better. The highly corrosive nature of most of the reagents, together with the importance of reducing losses of valuable metals to a minimum, are the main reasons for avoiding mechanical handling. The total handling loss in all refining operations is probably under 0.1 per cent.

Batch processes are also preferred to continuous processes because it is easier to check yields and make sure that precious metals are not going astray. For the same reason, namely accounting for precious metals, all units of plant must be easily accessible for cleaning out on the completion of batches.

The wet processes are operated in a building specially designed for this work after five years' experience in temporary premises. The principal feature is that the vessels are arranged on terraces. Successive steps of a process can be arranged in a line from the top of the building to the bottom, with gravity flow of the liquor from one vessel to the next. If a process requires more than five operations, the liquor from the fourth operation is elevated to one of the upper stages. In this way the number of times that the liquor has to be elevated is reduced to a minimum. Both acid eggs and centrifugal

acid pumps have been used for elevating these liquors and on past experience acid eggs are preferred.

The general layout of the building also facilitates supervision and control. The walls are built of white glazed bricks and the floors are constructed of chemical asphalt. Steam, water, vacuum, and compressed air are available on all the terraces. An overhead traveling crane enables any piece of plant to be replaced or moved to a different position.

In addition to a complete system for the removal and treatment of all fumes generated in the operations, general ventilation is obtained by ventilators in the roof supplemented by fan ventilation where required.

Chemical stoneware is the most generally used material for the construction of plant for refining processes involving the use of acids, the two principal types of vessels being mixers or vats up to 100 gal. capacity, and vacuum filters up to 80 gal. capacity. Aqua regia treatment of concentrates is normally conducted in steam-heated chemical stoneware vessels each of 140 liters capacity. A temperature of 90 deg. C. is readily obtained, which is adequate for dissolving the finely divided platinum, palladium and gold contained in the residues. Working under these conditions, there is the further advantage that there is no risk of bumping when heavy insoluble matter settles to the bottom of the vessel.

Dissolving Mineral Platinum

On the other hand, the conditions are quite different for dissolving mineral platinum, which is best done in gas-heated fused silica bottles of 70 liters capacity, using concentrated aqua regia at or near the boiling point. Evaporation of nitric acid solutions is done in similar fused silica bottles equipped with condensers suitable for the distillation of mineral acids. Nitric acid treatment is carried out in gas-heated 20 liter basins made of fused silica, which are also used for sodium bisulphate fusions. Sulphuric acid treatment is done in pans made of fine-grained grey cast iron, each of 25 liters capacity, and heated by gas.

Lead-lined wood and iron vessels are both used for liquors containing free sulphuric acid. Wooden tanks up to 300 gal. capacity, lined with soft rubber, are satisfactory for some of the operations, for instance, reactions in which sufficient free hydrochloric acid is present to make lead-lined vessels unsuitable. Acid-resisting hose is used to convey acid liquors and to make connections for removing fumes from reaction vessels.

Abstract of a paper read before a meeting of the Institution of Chemical Engineers, London, May 19, 1937.

Steel vessels lined with hard rubber are preferred to chemical stoneware vessels for operations involving the use of hydrochloric acid in which the heat of reaction causes a rapid rise of temperature. Porcelain plant is used for small-scale purification work.

An oil-fired boiler supplies low-pressure steam for process purposes and for general heating of the building. The vacuum system consists of two 10 to 17 hp. Nash Hytor centrifugal vacuum pumps maintaining a vacuum equivalent to 10 in. of mercury; a higher vacuum is considered inadvisable on account of the fact that stoneware filters are used. The vacuum mains consist of hard rubber pipes. Liquor catch pots and a vacuum scrubber protect the vacuum pumps from corrosion by acid liquors or fumes. Two air compressors, with automatic control to economize the power consumption, supply air for the acid eggs.

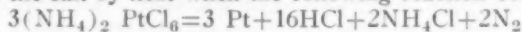
Drying of various intermediates and products, most of which are slightly acid, is done in gas-heated drying ovens, some of which are thermostatically controlled. Enamelled iron, boro silicate glass and ceramic dishes are used.

Residues, which sinter during calcining, or cake during drying, may have to be converted into powder for subsequent operations. For this purpose there are four 8 in. and one 14 in. disk pulverizers. Care is taken to collect and recover all dust produced during pulverizing by means of a fan and bag system.

The fumes given off during reactions include sulphur dioxide, sulphuric acid, chlorine, hydrochloric acid, oxides of nitrogen and nitrosyl chloride. Although stoneware fans can handle mixed acid gases such as these, it is more satisfactory to use an ejector in which the gases do not pass through the fan. In the latter system a fan delivers a jet of air at high velocity into a specially designed nozzle, which has the effect of creating sufficient suction to draw the fumes away from the reaction vessels. The acid fumes are neutralized in chemical stoneware scrubber towers by a sodium carbonate solution which is kept in circulation by centrifugal pumps.

The plant for the thermal decomposition of ammonium chloro-platinate and palladosammine chloride has been selected for special mention because it possesses some features of chemical engineering interest. Ammonium chloro-platinate can be converted into metallic platinum by reducing the moist salt with zinc dust, but the resulting platinum is contaminated by any impurities in the zinc and requires further treatment, including ignition, before it is

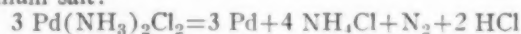
fit for sale. Consequently it is preferable to decompose the salt by heat when the following reaction occurs:



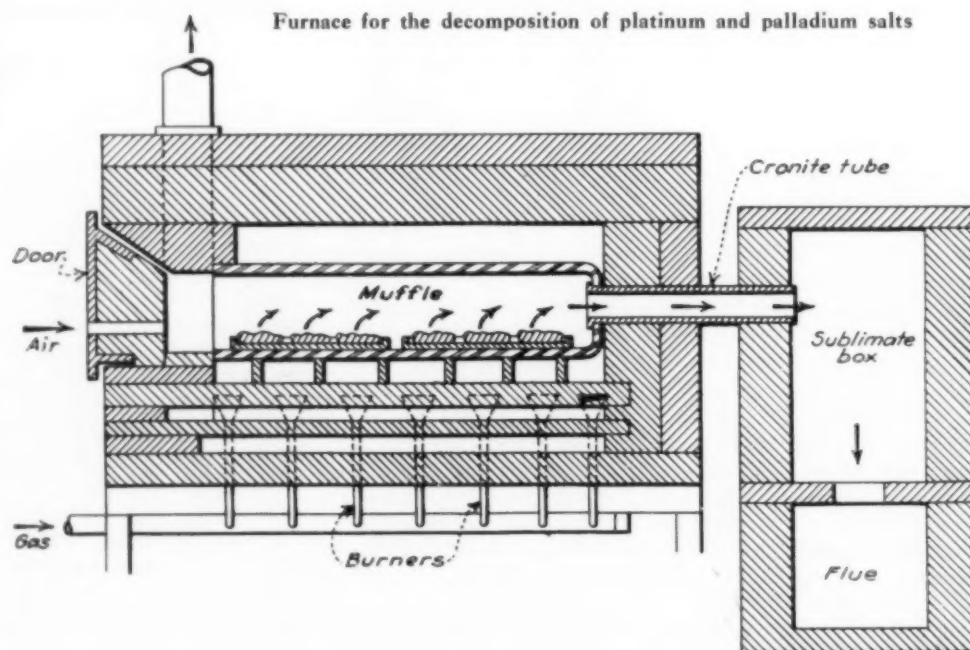
Although it is an easy matter to ignite a few grams of either of these salts under laboratory conditions, the decomposition of 50 kilos a day presents an engineering problem. The best solution of the problem was not obtained at the first attempt, but the comparatively simple arrangement of plant which has now been in use for several years, fulfills the essential requirements of: high purity of product; trouble-free operation; low cost of operation and maintenance; efficient collection, removal, and neutralization of the fume. The dry salt is placed in fused silica trays which are slowly heated in muffle furnaces fired by gas. Particular care must be taken while heating the material from 310-370 deg. C., after which the temperature is raised to 900 deg. C. to complete the removal of volatile matter.

In accordance with the recommendation of Treadwell the salt is wrapped in filter paper to reduce losses during decomposition. Treadwell also says there is a risk of the formation of volatile chlor-carbonyl compounds due to the action of carbon monoxide on the decomposing salt, but losses due to this cause can be avoided by careful operation.

The fumes evolved from the decomposing salt are drawn away through a Cronite tube, an alloy containing nickel, chromium and iron, into a sublimate box, where most of the sublimate settles, and then into a flue which leads to a central scrubbing plant where the hydrochloric acid is neutralized. As the fumes are particularly unpleasant it is important that the ammonium chloride, sublimate, should not be allowed to settle out prematurely and block the fume pipe. When decomposing palladosammine chloride it is advisable to place a small gas burner under the Cronite pipe as the fumes contain much more ammonium chloride than the fumes from the platinum salt:



and there is more likely to be trouble from blockage of pipes and flues.



Motor Control Design Trend Features

Higher Service and Greater Safety

By HERBERT SPEIGHT

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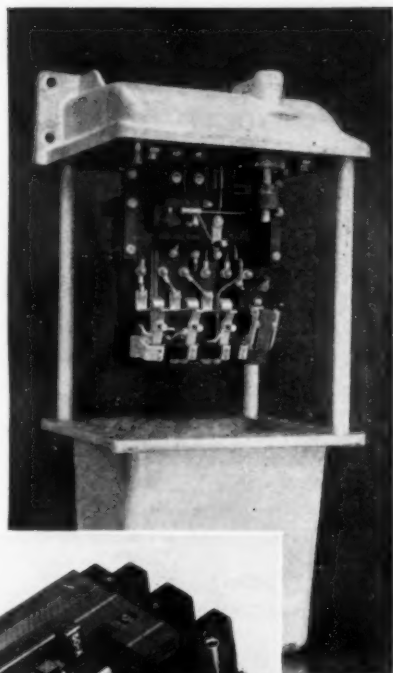


Fig. 1—Above: Oil immersed explosion resisting line starter with cover removed

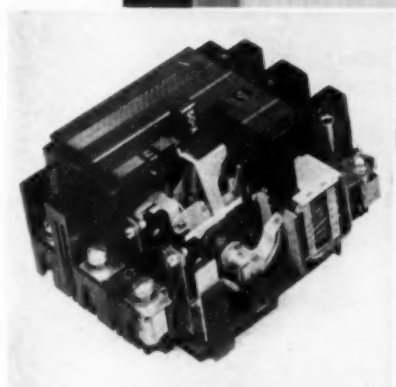


Fig. 2—Left: Three pole De-ion circuit breaker cut away to show arc quencher

COINCIDENT with the successful efforts that the process industries have recently been making in increasing production, lowering unit costs and applying automatic control to operations, electrical equipment manufacturers have given intensive study to improvements in the design and application of electrical equipment. What has happened in recent years to motor controllers is a case in point. Not only have better controls been developed, but they have been so designed as to facilitate installation, avert the corrosion of contacts, and promote safety. Matching the explosion-resisting characteristics of recent motor designs, the new controllers, when necessary, can be built for entirely safe operation in explosive atmospheres. Furthermore, they have been designed for safety in inspection and maintenance, with interlocking features which completely eliminate personal hazards.

A few words of explanation in regard to the starting characteristics of industrial motors will help to explain the improvements in starters that have been made. Momentarily, when power is thrown on a stationary motor, the current which flows amounts to seven to ten times the

rated current at full load. Then as the motor comes up to speed, a counter electromotive force is set up which at rated speed limits the current to that required to handle the load. Formerly, owing to the practical difficulty of connecting this heavy overload, motors were not braced to take care of such a momentary torque and all industrial motors were started at reduced voltage, generally employing an autotransformer from which taps were taken to a series of switch points, so chosen as to give the desired sequence of starting voltages.

Prior to about 1925, the tendency to chattering of starter contacts had not been entirely eliminated, and their use resulted in a series of makes and breaks with consequent arcing and burning of the contacting surfaces. Still another factor requiring the use of reduced starting voltages was the usual lack of adequate copper and proper design in the layout of plant power distribution circuits which, if across-the-line starting of motors had been attempted, would have resulted in excessive voltage drop in the lines to other motors and appliances connected to the system.

All of these factors, then, worked together to prevent the development of logical, simple methods of motor control. In addition, the physical shape of controllers tended to prevent economy in installation and simplicity of layout. Most process industries motors were controlled by single units, assembled close to the motor. Sometimes, in remote locations, groups of single units were mounted together on a framework. But in point of safety, convenience, good appearance and ready maintenance such installations were far from the compact, factory assembled units that are being installed today. At present, where single units are required as, for example, a motor and control remote from other equipment in a petroleum refinery yard, the tendency is to use an oil immersed unit of completely weatherproof design. When grouping is permitted by the physical layout of the process, then the units are likely to be assembled in what is known as the cubicle type of control board. With such an installa-

tion it is a simple matter to carry leads from the individual controllers to start-stop push button stations situated conveniently for the operator. Should the demands of safety make it desirable, less than the full line voltage can be carried to these push button stations, although owing to the care with which they are constructed, such a course is rarely necessary.

Thus, the economies and good appearance of grouped starting and protective equipment can be combined with the operating convenience of single units placed near the equipment they serve.

Enough has already been stated to show why reduced voltage starting was essential a few years ago. This situation has now changed. Contacts capable of connecting the full starting current have now been developed. Motors being built today are adequately braced to withstand the stresses of across-the-line starting. The hit or miss methods of earlier distribution system layout are being abandoned. In the entire range from fractional to 1,000 hp., motors at present are being controlled with across-the-line starters, with many advantages to their users.

It is no exaggeration to say that starters themselves have been revolutionized, as well as the circuit breakers which are replacing fused knife switches for motor and distribution system protection. The starting point in this development was the design of non-chattering, non-burning contacts. In one commonly used design, the alloy metal surfaces roll into contact with increasing pressure as the final closed position is approached. In opening, this motion is rapidly reversed. For protection of the circuit, the starter is combined with a breaker which in all except the smallest sizes, employs a two-way protective mechanism: instantaneous opening for short circuits and time-delayed opening for overloads of lesser magnitude. Excessive arcing, which destroys contacts and has been known to start fires on occasion, is prevented through the use of an arc quenching device which dissipates the arc completely and harmlessly within a few cycles.

One of the most interesting of these devices is the thermal overload protector used in many of these modern breakers. Since the effect of an overload is to overheat the motor and connecting wiring if continued for sufficient time, the logical method of protecting against an overload of short duration is to permit its continuance until such time as the temperature rise in the wire threatens to exceed a safe point. This is exactly what the thermal overload relay accomplishes. In a certain system an overload of say 25 per cent might be harmless and a properly adjusted breaker would permit it to continue. A still greater overload might, however, lead to a too elevated temperature in ten minutes, and the breaker would then interrupt the

current in somewhat less than this time, while with a still higher overload, the interruption would be necessary after, say, 20 seconds.

The importance of adequate arc dissipation cannot be overstressed. In the De-ion design used in the breakers described, the arc quenching element consists of a series of slotted steel plates mounted between supports of insulating material, placed so that the slots extend above the contacts. The moving contact passes through the slotted plates as it leaves the fixed contact. The arc formed as this action takes place is driven into the plates where it is cooled and de-ionized by the successive plates and air gaps between the plates. Hence the arc is entirely isolated from the operating mechanism, preventing any disturbance in the breaker proper.

Illustrating one type of explosion resisting controller, Fig. 1 shows an oil immersed linestarter with the cover removed. This unit has the starter at the bottom of the tank and the overload relay above the contactor. The De-ion breaker for protection is mounted on the panel

Fig. 3—Right: Oil immersed controller for assembly in a cubicle type panel board, with tank removed to show starter, circuit breaker and safety features

Fig. 4—Below: Cubicle type panel board equipped with oil immersed explosion resisting linestarters; panels have been removed to show starters and method of lowering the oil tank

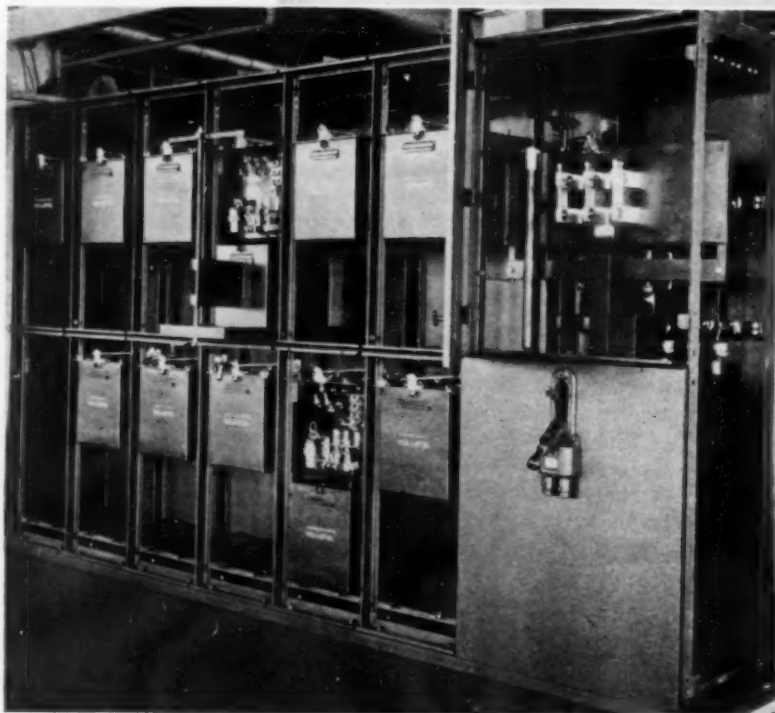
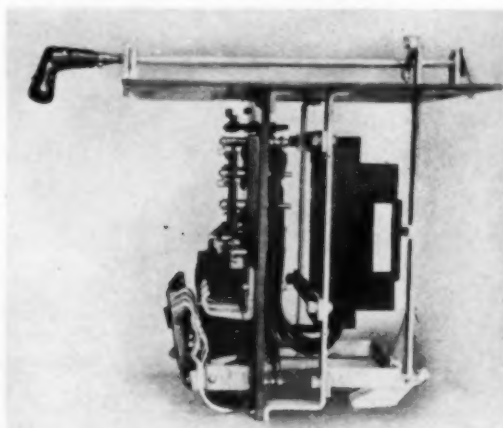




Fig. 5—Cubicle type panel board in a petroleum refinery; note on left-hand board the pistol grip handles which must be turned before panels can be removed

behind the contactor and the tank lowering mechanism is interlocked, demanding that the breaker be in the open position before the tank may be lowered. Fig. 2 illustrates one type of De-ion breaker. A starter of the type in Fig. 1 naturally has to be assembled in group form on a framework if mounted out in the yard, but no objection can be raised to the suggested method, when the unit can be assembled in close proximity to the equipment it serves.

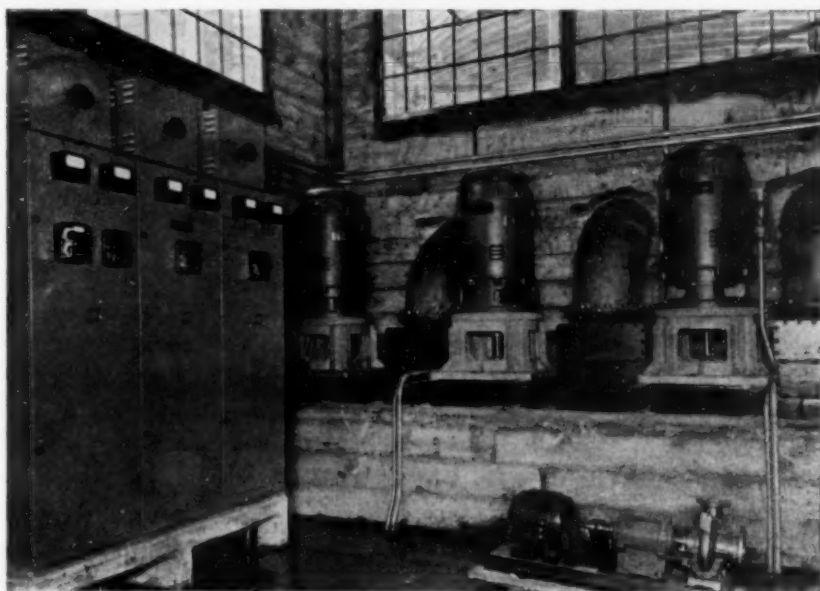
Another type of oil immersed control for the process industries is illustrated in Fig. 3, showing the assembly of the De-ion breaker and the interlocking mechanism which compels the breaker to open before the tank may be lowered. In addition, the lug at the bottom, pictured at the right, turns down when the tank is lowered from the starter when assembled in its usual location, and this arrangement interlocks the control, forcing the breaker to be in the "off" position when the tank is being assembled over the starter.

The type of starter illustrated by Fig. 3 is shown in Fig. 4 assembled into a switchboard which may be mounted under a shed roof. The ease of accessibility for removal of the tank or a complete unit is suggested by the simplicity of the lowering mechanism shown in the center of the picture.

It is clear from the figure that these starters can be disconnected in front and removed bodily from the control board at any time. The assembled complete board is illustrated in Fig. 5. When the pistol grip handle has been turned to close the De-ion circuit breaker, the operator is permitted to control the motor from a push button station located near by the motor.

The equipment shown illustrates the type of control that is receiving increasing attention throughout the process field. The group assembly, built complete at the equipment manufacturer's plant, has many advantages which are obvious from the illustrations. During construction the customer need not consider the assembly of unit parts as would be needed for the equipment shown in Fig. 1, but can request the manufacturer to furnish drawings showing where the motor leads must be brought to the cubicle board. The equipment will be received completely assembled and need only be held by four bolts on a flat slab of concrete.

Fig. 6—Below: Cubicle controls for 75 hp. vertical synchronous pump motors in screen room of a paper mill



Not only should an installation of this type be cheaper in initial overall cost, but it substantially reduces the hazard to the operator. It is impossible for unauthorized personnel to remove the front plate from the cubicle without first throwing the pistol grip switch into the "off" position. Naturally, the operation of this switch will shut down the equipment, notifying responsible operators that a mistake has been made which can promptly be rectified. Even if the plate is removed and the tank lowered, all parts inside the starter will be dead except the three leads to the De-ion breaker, which are covered.

Finally, in summary, we have noted the advantages that accrue from the use of modern starting equipment; that the use of oil immersed starters eliminates both corrosion and explosion hazards; and that complete overall assembly serves the needs of neatness, while it makes for greater safety for the plant personnel, lower installed cost and readier inspection, maintenance and repair.

Oil Refinery Hydrogen Sulphide Found to Be Economical Sulphuric Acid Source

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CONVERTING an industrial waste product into a highly profitable byproduct presents an opportunity for which chemical engineers and chemists are ever alert. When the waste product is one which might be the cause of a nuisance, the opportunity is doubly welcome. Such an opportunity presented itself in the El Segundo refinery of the Standard Oil Co. of California.

In this refinery is located one of the largest cracking plants in the western United States. The oil fed to this cracking plant is produced mainly from Southern California crude oils that are characterized by moderate to high sulphur contents, the raw crudes ranging from 0.5 per cent to as high as 2.5 per cent sulphur. The cracked naphthas which are produced are relatively high in sulphur content. Refinement of these naphthas and other products produced from Southern California crudes requires treatment with comparatively large quantities of sulphuric acid, treatment being made primarily for sulphur removal. Although approximately 50 per cent of the acid used in treating is regenerated in an efficient acid recovery system, expenditures for new acid required for make-up constitute a major item of refining expense. At the same time the gases produced in cracking contain from 4 to 6 per cent by volume of hydrogen sulphide. The quantity of sulphur contained in these gases is roughly equal to that required to produce the new acid used in the refinery. This condition of approximate balance is maintained even with changes in sulphur content of the crude oils processed in the refinery since both acid requirements for refinement and hydrogen sulphide content of the cracking plant gases are roughly proportional to the sulphur content of the crude oil.

Immediately adjacent to the refinery property is a sulphuric acid manufacturing plant of a large chemical company. Sulphuric acid is manufactured in this plant by the contact process and delivered to the refinery through a pipeline. Prior to the recovery of hydrogen sulphide from cracking plant gases, the sulphur used in the manufacture of this acid was shipped to the chemical plant in the form of brimstone from various remote points.

The gases produced in the cracking plant formerly were burned, without purification, in the furnaces of the cracking units and auxiliary plants and in the steam power plant that serves this portion of the refinery. In the combustion, the hydrogen sulphide was converted principally to sulphur dioxide with some small amounts of sulphur trioxide. The combustion gases were released to the atmosphere through the furnace stacks and were a

potential source of fume nuisance under certain weather conditions.

A further disadvantage in burning the high sulphur cracking plant gases was the increased maintenance costs for steel work on and near the furnaces, caused by corrosion resulting from absorption of the acid gases in moisture collecting on these surfaces during periods of high humidity.

It was apparent, therefore, from this combination of circumstances, that if a suitable method could be found for removing the hydrogen sulphide from the cracking plant gases and for recovering the hydrogen sulphide in a sufficiently pure form, the gas could be delivered to the chemical company for use as a substitute for brimstone, thereby effecting a considerable economy in refining operation and at the same time eliminating a possible source of fume nuisance.

Problems in Utilization

The problem that faced the engineers was three-fold: (1) To find a process fulfilling these requirements which, in addition, could be utilized with operating costs that would leave a reasonable margin of profit as return on the required investment; (2) to design a plant in which this highly toxic gas could be produced in substantially pure form without hazard to the operating personnel of this and adjacent equipment; and (3) to develop safe and satisfactory methods for delivering the hydrogen sulphide to the chemical plant and for continuously measuring and analyzing the gas as delivered.

For years the manufactured gas industry, and to a lesser extent a part of the natural gas industry, has had the problem of removing hydrogen sulphide from gas distributed for general use. Hydrogen sulphide must be removed from gases delivered for domestic use, not only because of the toxic hazard involved, but also because of the fact that much of the gas used for domestic purposes is burned in equipment that allows all or part of the products of combustion to escape into the room in which the equipment is used. If the gas contains sulphur compounds these are burned to sulphur dioxide and this gas

Presented before the Refining Division, Second World Petroleum Congress, Paris, France, June 14-19, 1937, under the original title, "Sulphuric Acid From Refinery Gases."

Brief details of this process were published on page 33 of the January, 1937, issue of *Chem. & Met.*, and with them an illustration showing an exterior view of the plant. Reference was also made to, and capacity figures given for, the first plant of this type in the East. This latter plant has been built at Philadelphia for the Atlantic Refining Co. A third plant has been reported under construction at Wayne, W. Va.

may reach noxious proportions in the confined space. A further object in purifying these gases is the prevention of corrosive action caused by hydrogen sulphide, at least in the presence of oxygen and water vapors.

The problem in the refinery was materially different from that of the gas industry. The concentrations of hydrogen sulphide in the gas to be processed were much higher than ordinarily encountered in the gas industry and the completeness of purification required was considerably less. Whereas the gas industry must obtain substantially complete purification of the gas, the problem in the refinery is primarily one of recovery of hydrogen sulphide and in the refinery the purified gas could contain hydrogen sulphide in concentrations that would be entirely unacceptable in the gas industry since the conditions under which the refinery gases are used are so widely different and no highly expensive and complicated distribution system is involved.

Most of the older gas purification processes used by the gas industry have two common disadvantages, so far as the refinery problem is concerned; that is, they are not economically applicable to gases containing relatively large amounts of hydrogen sulphide and the sulphur removed from the gas is not recoverable in a form suitable for use in the manufacture of sulphuric acid. In recent years a number of liquid purification processes that permit the recovery of the hydrogen sulphide gas in an almost pure state have been developed. The scrubbing solutions used in these processes have the properties of absorbing large volumes of hydrogen sulphide for each volume of solution and of readily releasing a large portion of the absorbed hydrogen sulphide upon boiling. Typical of these newer recovery systems are those in which the scrubbing liquors are aqueous solutions of sodium phenolate or of the higher amines.

The various liquid purification or recovery processes are quite similar and basically simple, consisting of three steps; (1) absorption of hydrogen sulphide from the foul gases in the fresh or reactivated solution; (2) stripping of the hydrogen sulphide from the foul solution; and (3) purification of the stripped hydrogen sulphide,

usually by simple cooling of the gas with the resultant condensation of excess water vapor and of the chemicals that may have been vaporized in the stripping operation.

The recovery system, utilizing sodium phenolate solution and licensed by Koppers Co., was selected for this installation.

Purification Plant

The sequence of steps and the flow of materials in the purification plant are illustrated by the accompanying flow diagram.

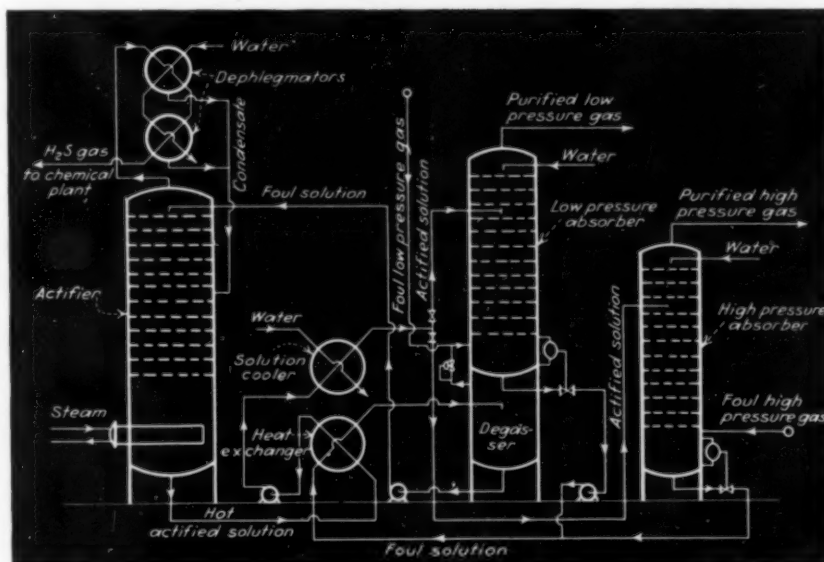
Gases from the cracking plant are delivered to two gathering systems. That for the high pressure gases operates at a pressure of 150 lb. per square inch, while that for the low pressure gases is maintained at 3 lb. per square inch. Separate absorbers of substantially identical design, except for thickness of shell and heads, are used for purification of the gases in these two systems. Each absorber contains 12 bubble plates of conventional design. The lower nine plates are used for countercurrent scrubbing of the gas with actified solution. At the top of each absorber tower a small quantity of water is introduced and contacted with the purified gas on the top three plates, the object being to prevent undue loss of chemicals in the processed gas. A practically automatic water balance is attained in the system by reason of the fact that the processed gases leaving the plant are saturated with water vapor at a slightly higher temperature than that of the entering gases. The foul solution from the lower sections of the absorbers passes through a heat exchanger in countercurrent flow with the hot actified solution and thence to a flash chamber, or "degasser." In this vessel the preheated foul solution is expanded to a lower pressure, permitting the major portion of the hydrocarbon material dissolved from the gases in the high pressure absorber to be vaporized. This is done to prevent contamination of the hydrogen sulphide with an undesirably high proportion of hydrocarbon gases. The gases and vapors released in the flash chamber pass through a pressure controller and into the low pressure absorber where most of the hydrogen sulphide is reabsorbed while the hydrocarbons escape with the purified low pressure gases.

The flashed solution is pumped from the flash chamber to the top plate of the actifier or regenerator. This unit consists of a conventional bubble plate column containing 12 bubble plates and equipped with a reboiler to supply the heat necessary to drive the hydrogen sulphide out of the foul solution.

Steam is used in the process as a heating medium.

As steam consumption represents one of the principal items of direct operating cost, serious consideration is being given to the installation of an auxiliary reboiler to utilize waste heat available in residuum from the cracking plant. The hot actified solution passes through the heat exchanger in which it is cooled by indirect heat transfer to the foul solution from the absorbers, then through.

Schematic flow diagram of sodium phenolate stripping process for hydrogen sulphide recovery



a cooler in which the remainder of the process heat is removed by cooling water. The solution is then returned to the absorbers to complete the cycle. The hydrogen sulphide released from the foul solution in the actifier, together with steam and chemical vapors, passes into the dephlegmator system in which the gas is cooled and the excess water vapor is condensed, together with the chemical vapors. The condensate formed in the dephlegmators is returned to the actifier, mixed with the actified solution and recycled. Cooling of the dephlegmators is accomplished by circulation of cold water from an outside source. The cooled gas passes from the dephlegmators to the delivery line to the chemical plant.

Control of operations in the recovery plant is largely automatic. The flow of solution is regulated by means of recording flow controllers of the orifice-meter type and by automatic liquid level controllers. The temperatures that are essential to process control are regulated automatically by means of recording temperature controllers. Process pressures are in a large measure automatically controlled by instruments within the purification plant or by controllers on the gas supply lines. Indicating or recording instruments are used for measurements of temperatures, pressures, and quantities where automatic control is not needed. The design and arrangement of the plant is such that the routine operating adjustments can all be made from the control panel which is located in a small building separated from the purification building.

Safety Precautions

Because of the highly toxic nature of the gas processed and recovered in the plant, a number of unusual design features were incorporated to provide maximum safety. All of the purification equipment except the pumps is housed in a gas-tight steel building. This housing is provided to eliminate the hazard to operating personnel that would result from leakage or rupture in the equipment handling concentrated hydrogen sulphide gas or solutions. The building inclosing the recovery plant consists of a structural steel frame covered with flat steel plates. On one side of the building these plates are bolted together with gas-tight gaskets in the joints. These plates, together with similar plates covering other access openings in the building, may be removed when necessary for inspection or maintenance of the purification equipment. The remaining walls and roof of the building are constructed of steel plates joined together with welded seams. At the top of the building is a steel stack rising to a height of 70 ft. above the ground. Within this stack is located a steam jet ejector that maintains the entire interior of the building under a slight negative pressure. Air is introduced for ventilation through ports located in the upper part of the building and is conducted to the floor of the building through internal ducts. As a further precaution the pressure release valves on the purification equipment discharge into a pipeline that opens into the base of a furnace stack situated at a considerable distance from the purification plant.

A small stream of the air leaving the purification building is removed at the base of the stack on top of the building and is conducted into two analyzers for hydrogen sulphide. One analyzer contains an optical system with a photo-electric cell to detect the change in turbidity of solution of a copper salt when any hydrogen

sulphide is present in the air leaving the purification building. By means of an amplifying system the impulse of the photo-cell is amplified to actuate the pointer of a dial indicating the concentration of hydrogen sulphide. The analyzer is so designed that it actuates (through a relay) an alarm signal whenever the hydrogen sulphide concentration exceeds any predetermined value that is considered the maximum consistent with safety. The second analyzer that serves as a check on the operation of the electric indicator gives a visual indication of the presence of hydrogen sulphide. A portion of the air sample is aspirated through two glass bubblers connected in series and containing potassium nitroprusside solution. The extent and nature of the color change is an indication of the hydrogen sulphide concentration. This analyzer and the indicating dial of the electric detector are mounted on the control panel of the plant.

Hydrogen Sulphide Delivery System

The problem of safely delivering, measuring, and analyzing the hydrogen sulphide produced in the purification plant and transported to the chemical plant for conversion into sulphuric acid required careful consideration of the factors involved and a considerable amount of experimental work to develop analytical procedures for which there was no adequate precedent. Delivery of the hydrogen sulphide to the chemical plant involved transportation through approximately 1 mile of the refinery property, passage under a main highway, and delivery to the sulphur burners in the chemical plant several hundred yards beyond the highway. To guard against the release of hydrogen sulphide to the atmosphere in the event of a leak in the pipeline, the welded gas transmission line was encased in a jacket construction of larger pipe with all joints welded. This outer casing is maintained under vacuum at all times by means of a steam jet ejector that discharges into the combustion space of a furnace adjacent to the purification plant. Thus, any leakage in the main line will be confined and delivered at a point where the toxic properties of the hydrogen sulphide will be destroyed by combustion. The gases drawn from the outer casing are tested at intervals of a few hours as a means of detecting any leakage of the main line before it can assume serious proportions. Connections for sampling the contents of the outer casing are welded to the casing at intervals of 100 ft. so that if leakage does develop the point at which the break has occurred can be determined within reasonable limits before repairs are undertaken.

The gas is metered at the delivery end of the pipeline through a positive displacement meter of the rotary type and the temperature and pressure of the gas at the point of metering are recorded continuously by suitable automatic instruments. All parts of the meter are constructed of chrome-nickel alloy to prevent corrosion by the moist hydrogen sulphide gas.

Development of a suitable method for continuously analyzing the gas delivered to the chemical plant involved numerous difficulties. A careful study of the characteristics of the various pieces of apparatus on the market indicated that none was suitable for the purpose and that it would be necessary to develop an automatic device for this purpose. After considerable experimentation a continuous sampling device of satisfactory characteristics was developed.

A small stream of the gas is continuously withdrawn

from the main pipeline at the point of metering, a uniform rate of withdrawal being maintained by means of a sensitive pressure regulator and a recording capillary tube meter. The gas sample is scrubbed with strong caustic contained in a large, especially constructed glass absorber which provides intimate contacting. The absorber is equipped with an overflow chamber which maintains a substantially constant head against the flow regulating mechanism. The residual gas subsequently passes through a small bubbler containing lead acetate solution to check the gas for completeness of hydrogen sulphide removal in the caustic scrubber. Aliquot portions of the caustic solution from the scrubber are analyzed for sulphide and carbonate in the refinery and chemical plant laboratories. The hydrogen sulphide content determined in this manner is used, together with temperature, pressure, and humidity, for determining the volume of pure hydrogen sulphide that has passed through the gas meter in the main delivery line.

Operation of the Plant

Commercial feasibility of the sodium phenolate process for hydrogen sulphide recovery from refinery gases has been demonstrated by operation of the El Segundo plant for a period of approximately six months. [At time of writing; operation was first started in August, 1936.—Ed.] During this time practically all of the gas produced in the cracking plant has been processed with a recovery of 94 to 97 per cent of the available hydrogen sulphide. The purity of the recovered hydrogen sulphide has ranged between 95 and 99 per cent, exclusive of water vapor. The impurities consist principally of carbon dioxide and hydrocarbon vapors.

The quantities of gas processed in the purification plant vary with changes of operation in the cracking plant. In general, the volume of the high pressure gas ranges between 10,000,000 and 13,000,000 cu. ft. per day at standard conditions, while that of the low pressure gas varies from 500,000 to 1,000,000 standard cu. ft. The hydrogen sulphide concentrations in both the high pressure and low pressure gas ordinarily are between 4 and 6 per cent by volume, although somewhat lower concentrations are encountered when cracking oils of relatively low sulphur content.

The degree of purification of the gases is determined by the extent to which the phenolate solution has been actified (freed of hydrogen sulphide), and the rate at which actified solution is supplied to the absorbers. Within the capacity limits of the equipment, these variables are controllable at will. Therefore, selection of the desired percentage of hydrogen sulphide recovery must be based on an economic balance between increased recovery and the resulting higher requirements for steam for heating and actification of the solution and power for solution circulation.

The following figures will illustrate the range of recoveries of hydrogen sulphide which have been found to be economically practical and the corresponding solution recirculation rates together with the steam consumption in the actifier.

	Hydrogen Sulphide Recovery, Per Cent	Solution to Absorbers, Gal. per Hr.	Steam to Actifier Lb. per 1,000 Cu. Ft. H ₂ S at S. C.
Low pressure gas....	85 to 90	1,500 to 3,500	
High pressure gas....	93 to 98	8,000 to 14,000	
Total gas.....	94 to 97	9,500 to 17,500	500 to 1,000

Chemical losses during operation of the process have been found to be moderate and, because of relatively low unit costs, these losses have not constituted a major item in operating expense.

Acid Manufacture

In the manufacture of sulphuric acid from hydrogen sulphide the net effect is to add four atoms of oxygen to one molecule of hydrogen sulphide. In actual operation, however, the process is not quite so direct. The hydrogen sulphide gas is burned in furnaces of suitable design to yield combustion gases containing sulphur dioxide, oxygen, nitrogen, and traces of carbon dioxide. The combustion gases also contain the water vapors resulting from the combustion of the hydrogen sulphide and traces of hydrocarbons that may be present, together with the water vapor introduced with the combustion air. The ratios of hydrogen sulphide and combustion air are so regulated that the combustion products will contain sulphur dioxide and oxygen in the proportions desired for catalytic conversion to sulphur trioxide.

The combustion gases are dried and subjected to the action of a contact catalyst in the same manner as combustion gases from brimstone. The sulphur trioxide produced in the contact mass is absorbed in strong acid in the usual manner. In general, it may be said that the manufacture of sulphuric acid from hydrogen sulphide is substantially identical with that in which sulphur is the raw material except for the simplification in design and operation of burners that is possible through the use of a gaseous fuel instead of solid fuel.

In this conversion 7,640 standard cu. ft. of hydrogen sulphide are chemically equivalent to 1 ton (2,000 lb.) of sulphuric acid. In actual operation a slightly greater volume of hydrogen sulphide is required because of process losses and incomplete conversion of sulphur dioxide to sulphur trioxide.

Under certain conditions the combustion of hydrogen sulphide for conversion to sulphuric acid will offer attractive possibilities of waste heat recovery since the gross heat of combustion of hydrogen sulphide is 658 B.t.u. per standard cubic foot. Obviously the economy of providing for recovery of this waste heat will depend upon the heat requirements in the plant in which the conversion is being accomplished.

Conclusion

Summing up, it may be concluded that for the particular conditions formerly existing in and near the El Segundo refinery, recovery of hydrogen sulphide from cracking plant gases and subsequent conversion to sulphuric acid offered an attractive opportunity to eliminate the possibility of noxious fumes, while at the same time reducing the operating costs of the refinery. Modern liquid purification processes are available for use in this operation. Suitable equipment has been designed for gas purification and for transporting, measuring, and analyzing the hydrogen sulphide recovered from the foul gases.

Both equipment and operation have been so planned as practically to eliminate the hazard of gas poisoning involved in the operation. Operation of the plant has been satisfactory and no serious difficulties have been encountered in the conversion of the hydrogen sulphide to sulphuric acid.

Inspecting and Testing PRESSURE STILL EQUIPMENT

General superintendent and general engineer, respectively, Refining Division, Empire Oil & Refining Co., Tulsa, Okla.

A NUMBER OF YEARS AGO when pressure distilling was first introduced to the oil refining industry operators looked upon this development with some disfavor because of the dangers and hazards involved. By proper design and proper selection of materials and equipment, it is now possible to install pressure stills which are entirely safe. This is accomplished by making proper allowance for corrosion and deterioration. The problem becomes one of maintaining the units by establishing a procedure of periodical inspection and testing of equipment as insurance against the failure of equipment which has become weakened over a period of time because of corrosion, erosion, fatigue, or normal deterioration. As there is no generally accepted practice, it has become customary for each operator of pressure stills to adopt some procedure of his own. The procedure outlined below has been successfully followed for a number of years and adequately covers the situation, but still does not overdo it.

The conventional manner of inspecting pressure vessels is by means of test holes which are drilled at such locations in the shell and heads as may be necessary or desired. The location of test holes is based for the most part on actual operating and corrosion experience. In other words, in most types of operations there are portions of the vessels which do not corrode at all, or, at

Based on paper presented before the Second World Petroleum Congress at Paris, France, June 14-19, 1937.

least, the corrosion is negligible. Obviously, there is no necessity for any extensive inspecting of these portions; however, it is advisable that they be checked occasionally. The test holes should be located in those portions of the vessel where appreciable corrosion occurs, as these are really the control points from a corrosion standpoint. The size of test holes must be adequate to permit wall thickness measurements to be made a sufficient distance away from drill contacts so that a true thickness reading can be obtained.

It is suggested that a suitable inspection form be prepared and used to record the findings on each vessel. This form should show either by sketch or adequate description the location of each test hole. Then for each test hole there should be recorded (1) the original thickness; (2) the thickness at time of inspection; and (3) the per cent decrease. Exhibit "A" is a typical inspection form for vessels. Successive inspections will reveal not only the current condition of the shell, but also the corrosion or erosion trend at each test hole, or at least in the general vicinity of each test hole. An identical procedure should be followed on each vessel nozzle except that each nozzle should be further described on the record form by specifying its service. It is not essential, but it is advisable to record on each vessel form the total barrels throughput at the time of each inspection. This makes it possible to compare corrosion not only against length of service but also against throughput.

Prior to the drilling of test holes it is, of course, necessary that the inside wall of the vessel be reasonably free of coke in order that thickness readings may not be in error. The cleaning of the inside surface can be most easily accomplished by sand blasting.

Upon the completion of thickness readings, the test holes should be tapped and plugs screwed in. The plugs are then welded over. At the time of the next inspection

they are hammer tested and if not in satisfactory condition, drilled out and replaced. These plugs are rechecked at each succeeding inspection.

The inspection of the vessel proper is completed by examining the seams for cracks or any other irregularities. Any seam that has failed should be chipped out as much as required and remolded in accordance with an approved welding procedure. Many vessels contain considerable internal equipment such as coils, trays, caps, pans, baffles, and supporting members. All such equip-

UNIT _____ PLANT _____ COMPANY _____ DATE _____

INSIDE OF HEATER

REMARKS: _____

Bridge Wall & Back Wall

REMARKS: _____

Front Wall

Exhibit "B" is a form for furnace inspection

ment should be inspected in substantially the same manner as the shell which contains it. If necessary, test holes should be drilled and, if not, this equipment should be hammer tested and checked by observation. Separate record forms should be maintained for all internal equipment.

All unit piping should be inspected in the same manner as outlined for vessels. Where needed, the test hole method should be followed and all piping should be thoroughly hammer tested. That portion of the piping system which is subjected to up and down conditions of high temperature and high pressure demands the most rigid examination. The various pieces of pipe should be properly identified and the inspection history recorded on suitable forms. Separate forms should be provided for all valves and for all fittings. As in the case of vessels, the record should show the original thickness, the present thickness and the per cent decrease for each valve, fitting, or piece of pipe.

The third most important phase of pressure stills concerns the furnace and furnace equipment. At the outset, elevation readings on the foundation should be taken to determine if any appreciable settling has taken place since the last inspection. If so, careful investigation should be made to determine the effects on the furnace structure. The side, back, front, bridge walls, arches, and all expansion joints should be examined and their condition recorded on a suitable inspection form, which should show by sketch or adequate description the location of any particular section of any wall. It is advisable to provide space on this form for repair recommendations which can be carried out immediately or at a subsequent shutdown. Exhibit "B" is a typical inspection form for furnaces. Auxiliary equipment, which should be examined, consists of: roof, tunnels, dampers, fans, stack and guys, doors, peepholes, burners and tube supports.

The inspection of tubes and return headers should be handled separately and on separate forms from the other furnace equipment. These two items of equipment are subjected to the most severe operating conditions and therefore require more frequent replacement and maintenance attention. The inspection, repairing, discarding, and replacement procedure should be identical to that used for piping and fittings, except test hole measurements which are of course replaced by caliper measurements because of more adequate accessibility. Devices have been developed for measuring tube thickness in or near the center, but it is not believed that such devices have come into general usage yet. Such a device is unquestionably of considerable value, but in general the controlling corrosion occurs very near the ends of tubes where caliper measurements can be easily made.

The examination of miscellaneous auxiliary equipment completes the pressure still inspection. This equipment consists of insulation, pressure, temperature, flow, and level instruments and gages, pumps, motors and wiring or other types of drivers, and safety valves. Excepting safety valves this equipment is inspected, repaired, discarded, and replaced in the conventional manner. It is not essential, but it is advisable to maintain an abbreviated inspection record form on all of these items.

Safety valves should be maintained in first class condition at all times and special precautions or regulations should be set up to insure that this is done. Upon inspection they should be carefully checked for cleanliness, condition of seats and relieving action.

After a complete inspection and reassembling of the equipment a cold oil pressure test should be put on the entire unit. The test pressure should be at least twice the unit operating pressure, which is usually obtained by the use of ram pumps. During the test all equipment should be rigidly inspected for failures, leaks or strains of any kind and if such is noted correction should be made prior to resuming operations. As the furnace tubes and return headers are subjected during operation to considerably more pressure than unit pressure, this equipment should be pressure tested separately to at least its operating pressure, if the twice unit pressure test on the entire unit does not equal furnace operating pressure. A test greater than operating pressure, of course, should be placed on tubes and headers if practical. These tests should certainly be made without fail after every complete or partial inspection of equipment, and if practically possible they should also be made prior to resuming operations after every shutdown.

Large Gain in Output of Coal-Tar Chemicals Last Year

PRELIMINARY figures for production of coal-tar chemicals in 1936 have been made available by the Tariff Commission and show that substantial gains in output were registered over the totals reported for the preceding year. In several groups, such as intermediates, dyes, synthetic resins, and miscellaneous non-coal-tar products, the activity in 1936 represents an all-time peak for the industry. Probably the outstanding increase occurred in the production of crude naphthalene, a serious shortage of which caused much concern early in 1936. Output of crude naphthalene increased 88 per cent to 89,536,202 lb. as compared with 47,653,372 lb. in 1935.

Output of tar increased about 25 per cent to 560,385,578 gal. while the quantities distilled amounted to 322,284,912 gal. or 16 per cent more than in 1935. Production of all crudes obtained from tar increased over the preceding year.

Among the products of coal-tar origin for which peak production was reported are intermediates, dyes, and resins. Intermediates output totaled 509,705,955 lb. or 16.7 per cent more than in 1935. There was an appreciable increase in production of intermediates for synthetic resins, such as phthalic anhydride, 33 per cent; phenol, 12 per cent; and maleic anhydride about 25 per cent. The volume of para dichlorobenzene, used largely as a moth repellent, increased 40 per cent; that of refined

naphthalene 13 per cent, aniline, 18 per cent, and nitrobenzene about 10 per cent.

The output of dyes was 17 per cent greater than that in 1935 and totaled 119,233,551 lb. of which 15,164,622 lb. were new and unclassified dyes. Synthetic indigo production increased 32 per cent and sulphur black in-

Production and Sales of Dyes and Other Synthetic Organic Chemicals

	1925-30 average	1935	1936
<i>Coal-tar chemicals</i>			
Intermediates:			
Production.....1,000 lb.....	267,492	436,656	509,706
Sales.....1,000 lb.....	109,133	190,917	223,119
Sales value.....Thousands of dollars	22,408	26,074	31,806
Finished coal-tar products: ¹			
Production.....1,000 lb.....	138,078	² 272,728	³ 335,091
Sales.....1,000 lb.....	133,964	² 230,381	³ 286,033
Sales value.....Thousands of dollars	65,027	² 98,792	³ 119,498
Dyes—			
Production...1,000 lb.....	94,003	101,933	119,233
Sales.....1,000 lb.....	92,207	97,954	117,256
Sales value...Thousands of dollars	39,428	51,488	62,822
Medicinals—			
Production...1,000 lb.....	4,508	10,023	12,034
Sales.....1,000 lb.....	4,106	8,950	10,079
Sales value...Thousands of dollars	7,464	8,372	9,762
Flavors and perfume materials—			
Production...1,000 lb.....	3,966	4,364	⁴ 3,481
Sales.....1,000 lb.....	3,919	4,080	⁴ 3,436
Sales value...Thousands of dollars	2,901	3,172	⁴ 3,220
Coal-tar resins—			
Production...1,000 lb.....	⁵ 24,442	² 90,913	³ 116,334
Sales.....1,000 lb.....	⁵ 22,135	² 65,923	³ 85,286
Sales value...Thousands of dollars	⁵ 7,756	² 12,777	³ 16,652
<i>Non-coal-tar chemicals</i>			
Production...1,000 lb.....	379,972	1,591,896	2,041,454
Sales.....1,000 lb.....	264,006	791,760	1,034,921
Sales value...Thousands of dollars	44,499	86,334	105,831

¹ Includes color lakes, rubber chemicals and miscellaneous coal-tar products not shown separately.

² Does not include coumarone and indene resins.

³ Does not include resins derived from coumarone and indene, styrol, hydrocarbons and sulphonamides.

⁴ Decrease.

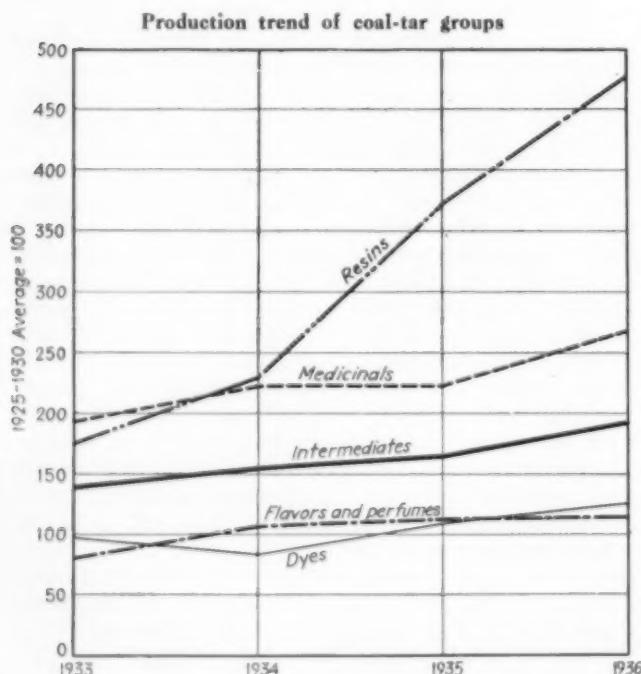
⁵ 1927-30 average.

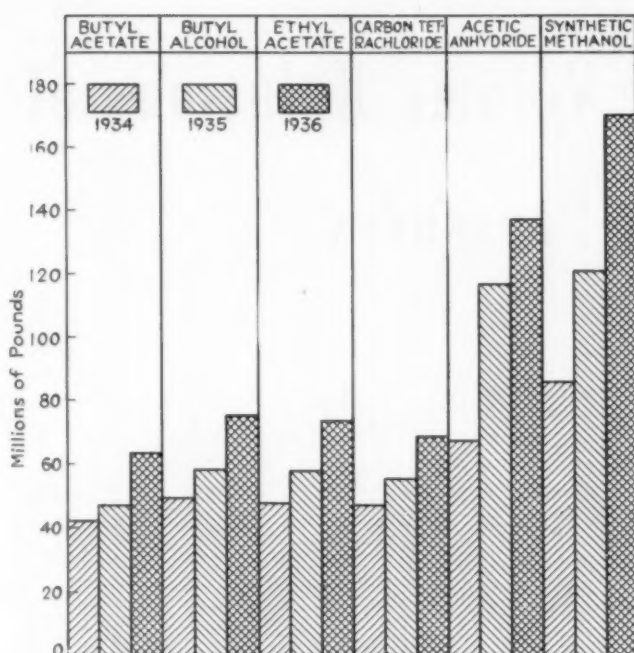
Production and Sales of Dyes and Other Finished Coal-Tar Products, 1936

	Production Lb.	Sales Lb.	Value
Dyes—			
Classified.....	104,068,929	103,105,580	\$46,497,383
Unclassified.....	15,164,622	14,151,196	16,324,800
Total.....	119,233,551	117,256,776	\$62,822,183
Color lakes and toners.....	15,352,334	13,575,454	10,177,276
Medicinals.....	12,033,857	10,079,473	9,762,555
Flavors and perfume materials.....	3,480,981	3,436,761	3,220,388
Resins ¹	116,334,635	85,285,926	16,652,415
Rubber chemicals.....	30,753,901	21,563,223	8,391,067
Miscellaneous ²	37,902,097	34,835,741	8,471,866
Total ¹	335,091,356	286,033,354	\$119,497,750

¹ Does not include resins derived from coumarone and indene, styrol, hydrocarbons and sulphonamides.

² Includes benzoate of ammonia, benzoate of soda, benzoyl peroxide, biological stains and chemical indicators, diazo salts, poisonous and tear gases, synthetic insecticides, naphthol AS and derivatives, synthetic tanning materials, textile assistants, photographic chemicals, and others.





Production trend of certain synthetic organic chemicals

creased 21 per cent over 1935. Sales of all dyes, considered as a group, were 20 per cent greater in 1936 by quantity and 22 per cent by value than in the preceding year.

Another gain made by the industry in 1936 was in the production of synthetic resins of coal-tar origin, the total of which was 116,334,635 lb., with sales of 85,285,926 lb. valued at \$16,652,415. The growth of this industry is shown by comparing the 1936 output with the average output for the period 1927-30 of 24,442,000 lb. Resins derived from tar acids (phenol, cresols, and xylenols) increased in output to 69,382,183 lb. or 30 per cent more than in 1935. Alkyd resin production totaled 46,952,452 lb. or more than 35 per cent higher than 1935.

Production of non-coal-tar synthetic resins totaled 15,611,041 lb. with sales of 14,766,640 lb. valued at \$3,591,467. This group includes resins derived from acrylic acid esters, vinyl acetate and chloride, urea and thiourea, petroleum, and other sources. Commercial production of petroleum resins was reported for the first time in 1936.

In the field of synthetic medicinals, a 20 per cent increase in output, 13 per cent in sales quantity and 17 per cent in sales value, is noted for those of coal-tar origin. Commercial production of mandelic acid and salts is reported for the first time. Aspirin and salicylic acid USP account for the bulk of production in this group, while aspirin, medicinal dyes, and the arsphenamines account for a large part of the value of sales.

Synthetic non-coal-tar medicinals increased in sales to 1,205,403 lb. valued at \$1,878,944 as compared with 568,839 lb. valued at \$1,343,008 in 1935. Interesting developments in this group include commercial production of synthetic thymol, and increased output of synthetic menthol and theophylline derivatives.

Organic color lakes and toners increased 8 per cent in output, 12 per cent in sales quantity and 17 per cent in sales value over 1935. Rubber chemicals of coal-tar origin increased 30 per cent in output to 30,753,901 lb., of which 57 per cent were accelerators and 43 per cent antioxidants.

Among the synthetic organic chemicals not of coal-tar origin, many increases in production are noted. The output of this group totaled 2,041,454,244 lb. or 28 per cent more than in 1935. Sales of 1,034,921,170 lb. valued at \$105,831,590 represent an increase of 30.7 per cent by quantity and 22.6 per cent by value as compared with the preceding year. Individual products for which increased production is noted include methyl ethyl ketone, more than 100 per cent; isopropyl alcohol and methanol, more than 40 per cent; formaldehyde, 25 per cent; acetone, more than 30 per cent; carbon tetrachloride, 23 per cent; ethyl acetate, 27 per cent; and ethyl alcohol, about 20 per cent.

Production and Sales of Synthetic Organic Chemicals of Non-Coal-Tar Origin, 1936

	Production Lb.	Sales Lb.	Value
Medicinals.....	1,214,647	1,205,403	\$1,878,944
Flavors and perfumes....	1,189,517	1,158,629	858,453
Resins.....	15,611,041	14,766,640	3,591,467
Miscellaneous ¹	2,023,439,039	1,017,790,498	99,502,726
Total.....	2,041,454,244	1,034,921,170	\$105,831,590

¹Includes non-coal-tar rubber chemicals, and all other non-coal-tar synthetic organic chemicals, publishable statistics for which are shown in tables 11 and 12.

Production and Sales of Certain Synthetic Resins, 1936

	Production Lb.	Sales Lb.	Value
Total ¹	116,334,635	85,285,926	\$16,652,415
Derived from:			
Phenol.....	50,635,448	48,125,099	9,015,339
Phenol and cresols.....	7,281,897	3,600,595	1,019,560
Cresols and xylenols.....	11,464,838	9,217,697	1,305,395
Phthalic anhydride and maleic anhydride.....	46,952,452	24,252,535	5,312,121
Total.....	15,611,041	14,766,640	\$3,591,467

¹Does not include resins derived from coumarone and indene, styrol, hydrocarbons and sulphonamides.

²Includes resins derived from: abalyn-hydrogen-nitrogen, abietic acid, acrylic acid esters, adipic acid, petroleum, terpenes, urea, urea and thiourea, vinyl compounds, and wood rosin-methyl alcohol.

Production and Sales of Certain Miscellaneous Synthetic Chemical Products, 1936

	Production Lb.	Sales Lb.	Value
Total.....	37,902,097	34,835,741	\$8,471,866
Naphthol AS and derivatives:			
Naphthol AS.....	273,397	314,076	375,803
Naphthol AS, BS.....	71,029	.....	.....
Photographic chemicals:			
Hydroquinol.....	784,698	765,154	558,236
Phthalates—Total.....	10,273,647	10,162,325	1,914,139
Dibutyl.....	5,644,166	5,301,280	919,728
Diethyl.....	700,686	856,328	142,795
Textile assistants—Total.....	2,160,288	2,269,184	674,993
Of Non-Coal-Tar Origin:			
Acetic anhydride (from all sources).....	136,889,876	.....	84,892
Acetin (mono, di, tri).....	250,719	224,102	4,066,906
Acetone.....	94,565,804	64,651,128	.....
Acetyl chloride.....	8,053	.....	.....
Amyl acetates.....	10,222,991	11,776,930	1,160,960
Amyl alcohols.....	11,473,212	2,888,669	355,313
Butyl acetates.....	63,335,767	52,749,654	4,366,367
Butyl alcohols.....	75,327,184	41,007,744	3,263,700
Carbon tetrachloride.....	68,460,947	62,282,020	2,569,921
Chlorinated solvents ¹ —Total.....	50,300,527	42,304,433	3,025,588
Ethyl acetate (85% purity).....	73,413,681	55,778,905	3,447,043
Ethyl ether (tech., USP and absolute).....	9,213,707	10,068,272	1,547,452
Ethyl propionate.....	389,977	.....	.....
Gallie acid, tech.....	310,176	.....	.....
Isopropyl alcohol (isopropanol).....	140,525,185	.....	.....
Methanol (synthetic).....	169,933,374	101,724,372	4,286,180
Methyl chloride (chloromethane).....	3,106,419	3,181,487	1,032,677
Oxalic acid.....	9,355,869	9,055,969	950,919
Pyrogallie acid (Pyrogallol).....	95,694	83,163	114,527

¹Includes ethylene dichloride, dichloroethylene, dichloromethane, hexachloroethane, pentachloroethane, perchloroethylene, tetrachloroethane, tetrachloroethylene, trichloroethane, and trichloroethylene.

Nomographic Charts for Volume Relations of Gases at High Pressures

By D. S. DAVIS

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WATERTOWN, MASS.

WITH THE ADVENT of high pressure processes attention has focused on the failure of the ideal gas laws to serve the purposes of the engineer in an adequate manner, as delineated so clearly by the 1936 Perkin Medallist, Prof. W. K. Lewis (*Chem. & Met.*, **43**, 1936, p. 32; *Ind. Eng. Chem.*, **28**, 1936, p. 257). For instance, the use of the perfect gas laws in calculating the volumes of hydrogen, nitrogen, and carbon monoxide when compressed at 0 deg. C. from atmospheric pressure to 800 atm. results in values which are, respectively, 36, 44, and 45 per cent too low, the discrepancies growing with increasing pressure.

Compressibility Factors Determined

The ideal gas laws can be corrected through the use of experimentally determined compressibility factors which depend upon temperature and pressure and which are found to vary from gas to gas.

These compressibility factors have been reported by the Fixed Nitrogen Research Laboratory, U. S. Department of Agriculture, and cover the industrially important carbon monoxide, hydrogen, nitrogen and a 3:1 (by volume) mixture of hydrogen and nitrogen (Bartlett, *J. Am. Chem. Soc.*, **49**, 1927, p. 1955; Bartlett, Cupples and Tremearne, *ibid.*, **50**, 1928, p. 1275; Bartlett, Hetherington, Kvalnes and Tremearne, *ibid.*, **52**, 1930, p. 1363; and Bartlett, Hetherington, Kvalnes and Tremearne, *ibid.*, **52**, 1930, p. 1374).

For temperature conditions corresponding to the subscripts, 1 and 2, the corrected gas law becomes

$$V_2 = V_1 \frac{P_1}{P_2} \frac{c_2}{c_1} \quad (1)$$

where V and P are volumes and pressures, respectively, and c is the compressibility constant for a given temperature and pressure.

J. R. Dilley (*Chem. & Met.*, **38**, 1931, p. 280) has made the excellent compressibility data more readily usable through the preparation of charts for each of the four gases. In these, for various temperatures, the quotient of P and c , designated as the volume relation factor, f ,

is plotted against the pressure. Since $f_1 = P_1/c_1$ and $f_2 = P_2/c_2$, equation (1) becomes

$$V_2 = V_1 \frac{f_1}{f_2} \quad (2)$$

The plots are a distinct improvement but they still leave much to be desired from the standpoint of interpolation. The factor—pressure isotherms are nearly linear up to about 150 atm. but show considerable curvature between 150 and 1,000 atm. In addition, the temperatures covered increase in uneven steps, as —70, —50, —25, 0, 20, 50, 100, 200, and 300 deg. C., for hydrogen, and the

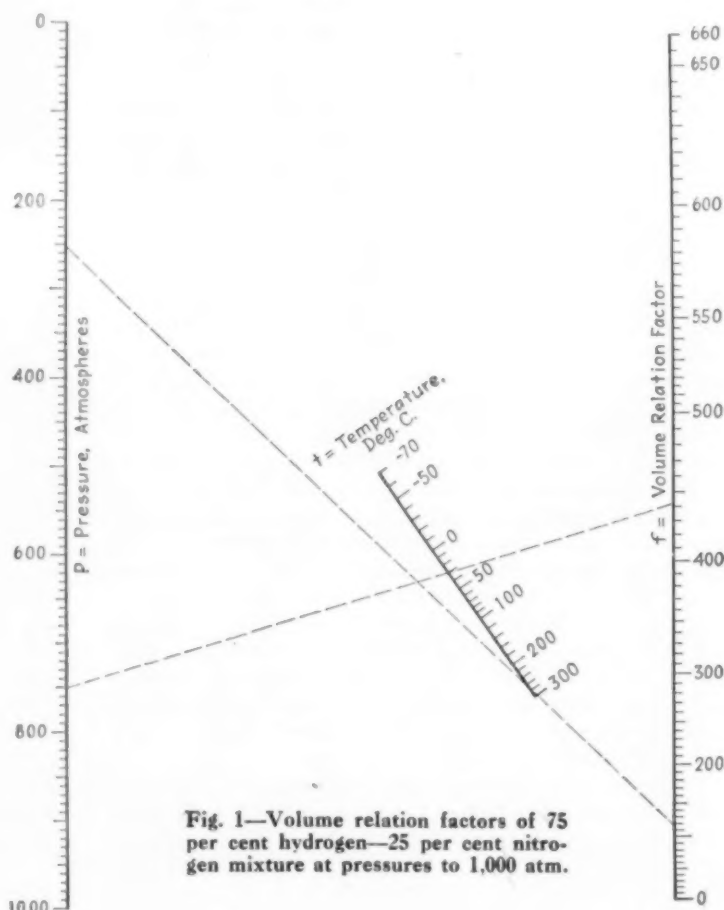
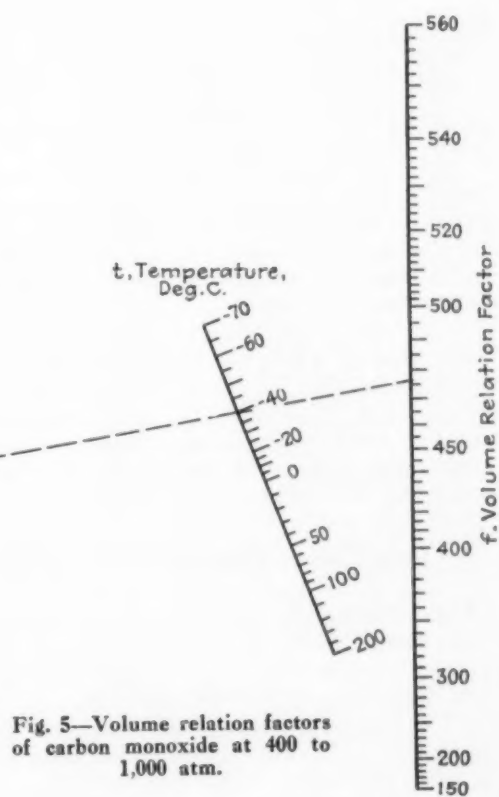
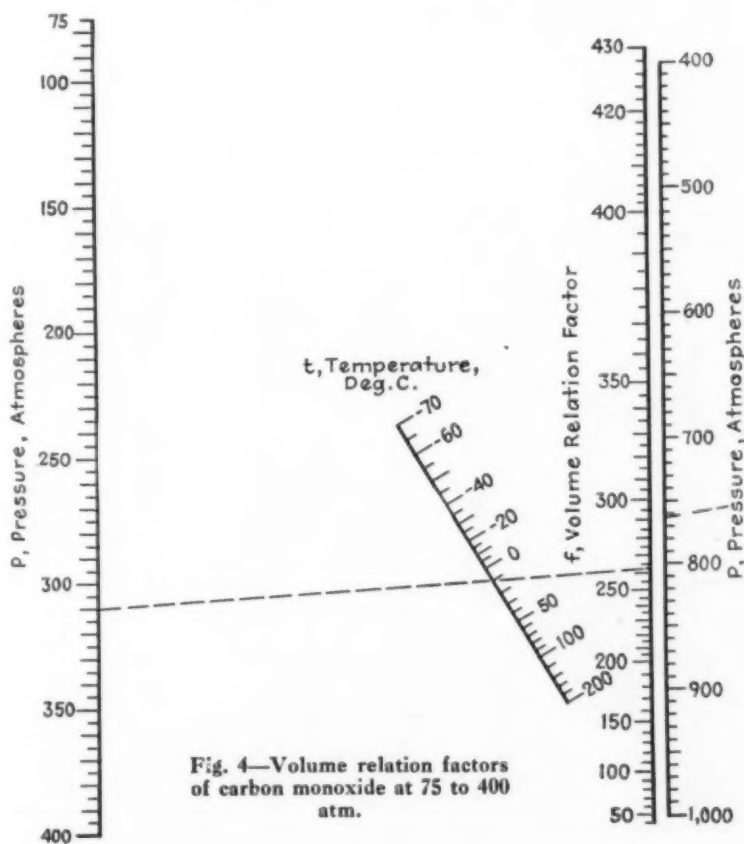
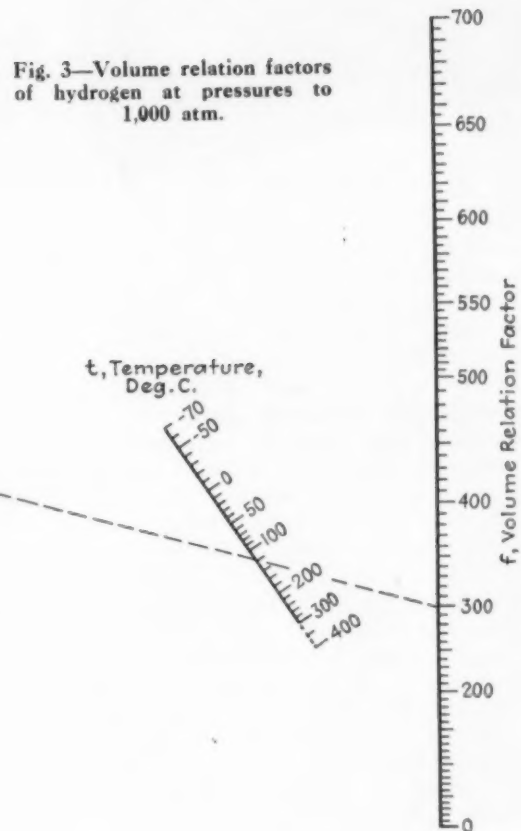
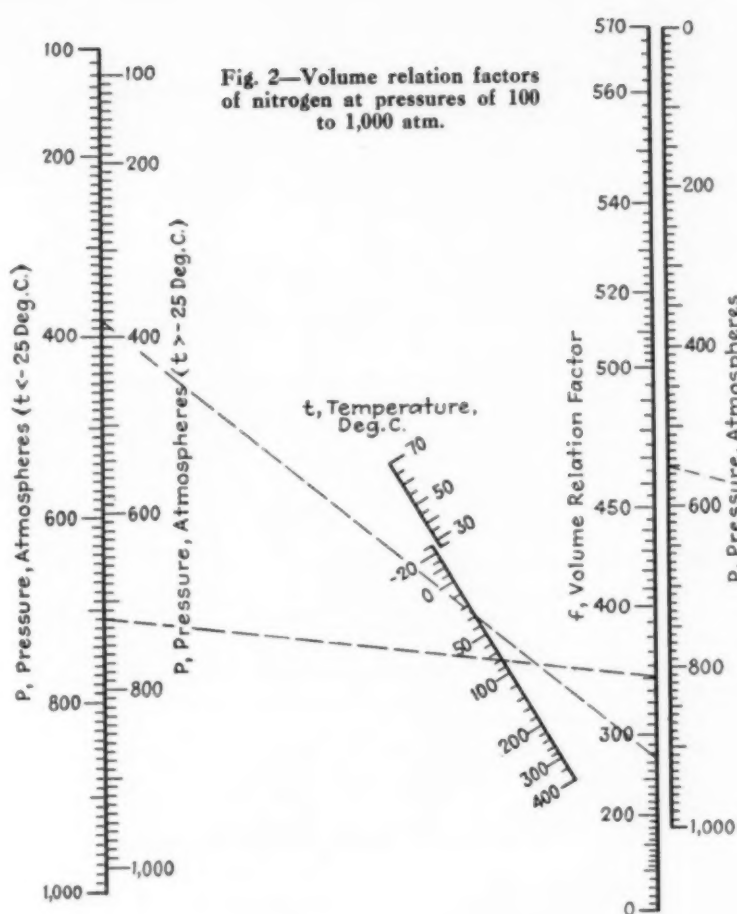


Fig. 1—Volume relation factors of 75 per cent hydrogen—25 per cent nitrogen mixture at pressures to 1,000 atm.



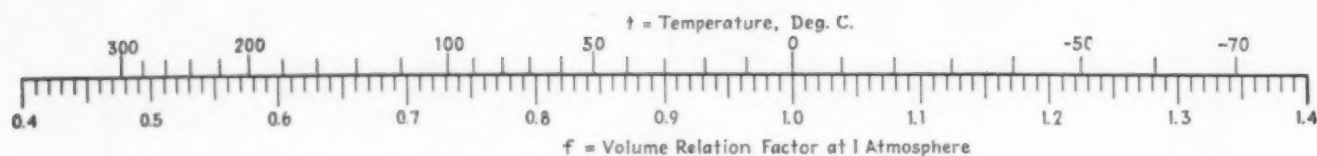


Fig. 6—Volume relation factors of nitrogen, hydrogen, their mixtures, and carbon monoxide at a pressure of 1 atm.

scales are graduated to only 50 units in volume relation factor and to only 100 atm. Thus, while it is fairly easy, in the case of hydrogen, to read the factor corresponding to exactly 600 atm. and exactly 100 deg. C., it is difficult to interpolate f for, say, 640 atm. and 160 deg. C.

There is evident need for a different sort of graphical representation of pressure, temperature, and volume relation factor data such that interpolations can be made along closely graduated scales with greater accuracy and facility. These requirements are met by the accompanying five line coordinate charts, where, in each case, it is sufficient to connect values on the pressure and temperature scales with a straight edge in order to read the volume relation factor with gratifying ease and accuracy. The charts are based directly upon the original data of the Fixed Nitrogen Research Laboratory and have resulted from close studies of the relationships between the pressures and factors at the various temperatures.

The use of the charts is illustrated as follows: Given 100 cu. ft. of a 3:1 mixture (by volume) of hydrogen and nitrogen at 750 atm. and 30 deg. C.; what is the volume at 250 atm. and 260 deg. C.? One reads the volume relation factors, f_1 and f_2 , corresponding to the initial and final conditions and substitutes them in equation (2). In Fig. 1 a line connecting $P = 750$ with $t = 30$ crosses the f -scale at 442, the value of f_1 . Similarly, a line connecting $P = 250$ with $t = 260$ indicates a value of 114 for f_2 . The volume under the final conditions is then $V_2 = 100(442/114) = 388$ cu. ft.

When the volume at a given pressure and temperature is known the charts can also be used to determine either the pressure or temperature required to yield a new volume. The value of f_1 is first found and f_2 is calculated by transposing equation (2) into the form, $f_2 = (V_1/V_2)f_1$. Then the unknown pressure or temperature value is read from the chart. Thus, if 25 cu. ft. of nitrogen at 720 atm. and 80 deg. C. is expanded to 32 cu. ft. at 380 atm. what final temperature will be required? Reference to Fig. 2 shows that the volume relation factor is 353 when $P = 720$ and $t = 80$. Hence $f_2 = (25/32)353 = 276$. A line connecting 276 on the volume relation scale with 380 on the pressure scale crosses the temperature scale at the desired value, 31 deg. C. In using the nitrogen chart note that there are two pressure scales, one for use at temperatures below -25 deg. C., the other for temperatures above this point.

Two Charts Cover Carbon Monoxide

The following example will serve to illustrate the use of the carbon monoxide charts, Figs. 4 and 5, the former covering pressures between 75 and 400 atm. and the latter pressures between 400 and 1,000 atm. If 200 cu. ft. of carbon monoxide at 310 atm. and 10 deg. C. is compressed to 110 cu. ft. at a temperature of -40 deg. C., what pressure is required? Reference to the low pressure chart, Fig. 4, yields a volume relation factor of

262.5 under the initial conditions. The final factor is given by $(200/110)262.5 = 477$. Aligning $f = 477$ with $t = -40$ on the high pressure chart, Fig. 5 results in a pressure value of 762 atm.

At atmospheric pressure the volume relation factors for all four gases are nearly identical, with values obtained from the expression $273 \div (273 + t)$, where t is the temperature in degrees Centigrade. For convenience they can be read from Fig. 6, the use of which is shown as follows: 2,500 cu. ft. of hydrogen at 1 atm. and 40 deg. C. is put under a pressure of 550 atm. at 120 deg. C.; what is the final volume? Opposite 40 deg. the value of f_1 is read to be 0.872 in Fig. 6, while f_2 is found to be 298 through aligning $P = 550$ with $t = 120$ in Fig. 3. The final volume is $2,500(0.872/298) = 7.32$ cu. ft. In connection with the hydrogen chart, Fig. 3, it should be mentioned that the dotted portion of the temperature scale between 300 and 400 deg. C. is restricted to use with pressures below 400 atm., the highest pressure covered by the original data at 400 deg. C.

Calculation Shows Chart Accuracy

The accompanying tabulation shows the nature of the agreement between volume relation factors as read from the charts and those calculated directly from the data upon which the charts are based. With almost every combination of temperature and pressure values the charts are good to well within 1 per cent.

Calculated Volume Relation Factors Compared With Chart Factors

Gas	Temp., Deg. C.	Pressure, Atm.	Volume Relation Factors Original Data	Chart	Per cent Deviation
75% H ₂ — 25% N ₂	—70	100	128	130	1.6
	—50	200	216	218	0.9
	—25	300	272	272	0.0
	0	400	310	310	0.0
	25	400	290	290	0.0
	50	600	362	363	0.3
	100	600	326	325	—0.3
	199	800	334	335	0.3
	300	1,000	339	340	0.3
	—70	100	125	125	0.0
H ₂	—50	200	213	212	—0.5
	—25	300	270	270	0.0
	0	400	312	312	0.0
	50	400	272	272	0.0
	100	600	333	334	0.3
	199	800	345	345	0.0
	299	1,000	356	355	—0.3
	400	400	145	145	0.0
	—70	100	157	168	7.0
	—50	200	255	260	2.0
N ₂	—25	300	295	294	—0.3
	0	400	318	316	—0.6
	50	400	269	270	0.4
	100	600	305	306	0.3
	199	800	302	302	0.0
	300	1,000	301	300	—0.3
	400	1,000	269	268	—0.4
	—70	100	163	164	0.6
	—50	200	261	259	—0.8
	—25	300	297	297	0.0
CO	0	400	320	320	0.0
	25	400	294	293	—0.3
	50	600	345	347	0.6
	100	600	307	306	—0.3
	150	800	327	328	0.3
	200	1,000	342	342	0.0

New Titles Cover Varied Fields

SCIENCE OF CORROSION

METALLIC CORROSION PASSIVITY AND PROTECTION. By *Ulick R. Evans*. Published by Edward Arnold & Co., London; American agent, Longmans, Green & Co., New York. 682 pages plus index. Price, \$15.

Reviewed by *James A. Lee*

INSTEAD of revising his former book on corrosion, Professor Evans found the situation demanded an entirely new book summarizing the existing knowledge. He has based the new volume on the investigations of a large number of students of the subject, and in addition on the research work carried out since 1923 at Cambridge University. In preparing the book he has borne in mind two separate groups of readers, the practical man and the pure scientist. To appeal to these groups, he has divided each chapter into three sections. The (A) sections are devoted to the scientific basis, the (B) sections discuss practical problems, while the (C) sections provide a very elementary, quantitative discussion of those cases which are sufficiently simple to be represented by equations. In these third sections the simplicity of the equations which serve to represent some of the corrosion changes is perhaps somewhat surprising, and in cases where algebraic treatment would be complicated the argument is expressed satisfactorily by means of a graphical construction. The (C) sections also include certain arguments—in some cases, speculative—which, although not mathematical, may prove difficult to the elementary reader. If the reader who objects to mathematics will confine himself to the (A) and (B) sections he will find that the story is told without gaps in the arguments and that—except for footnotes—the symbols to which he takes exception are entirely absent.

In assigning the matter among the chapters, the author has based the arrangement on the scientific causes of phenomena. He states that any other arrangement would defeat the main purpose of the book; it is desired not merely to state the facts, but to give understanding of what lies behind them, since without that understanding the

applications of remedies may be positively dangerous. This arrangement is probably not as convenient to the chemical engineer as some other would be.

This volume has another possible objection: there is a vast amount of material of little or no value to the chemical engineer and therefore he will find it difficult to locate any particular subject matter. However, it is worth adding to a book-shelf on materials of construction for the author is one of the world's outstanding authorities on corrosion.

PHARMACEUTICAL CENTENARIAN

THE UNITED STATES DISPENSATORY, 22nd Edition. Edited by *H. C. Wood, Jr.* and *C. H. LaWall*. Published by J. B. Lippincott Co., Philadelphia, Pa. 1,894 pages. Price, \$15.

EIGHT YEARS of preparation are represented in this latest revision of a distinguished book, distinguished because it is a scientific work which has achieved the rare record of surviving as a leading reference in its field for over 100 years. Most individuals engaged in the fine chemicals industries will know that the U. S. Dispensatory is an encyclopedia of drugs and medicinal chemicals used in the United States, Canada and Great Britain. Later editions of the book have gone further than this to include substances which are not strictly speaking medicines but which are of importance because of their chemical or toxic properties. It is in this respect that chemists and chemical engineers will find the present edition of greater value than any of its predecessors.

The book is divided into three parts: Part I includes those drugs officially recognized in the U. S. Pharmacopoeia, the British Pharmacopoeia and the National Formulary. It embraces all of the changes and additions contained in the latest revisions of these official works. Treatment of the various hormones, vitamins, and so-called biologicals has been expanded in particular to include the revolutionary developments which have taken place in these

fields during the past decade. Part II covers the unofficial drugs, and there an attempt has been made to describe "every chemical individual sold as a medicine in the United States." This section contains many newly-added substances which are of little therapeutic importance but which have been included because of their commercial or scientific interest. Part III contains miscellaneous matter such as general test procedures, methods for preparing reagents, and varied chemical and physical data.

It is sufficient commendation to say that this edition ably carries forward the high standard of usefulness set by its predecessors.

ANALYSIS STANDARDS

REAGENT CHEMICALS AND STANDARDS. By *Joseph Rosin*. Published by D. Van Nostrand Co., Inc., New York City. 530 pages. Price, \$6.

PROGRESS in analytical chemistry from the time twenty years ago when the smallest determinable quantity of many of the elements was one milligram, to present-day accuracy which brings quantities as low as one-hundredth of a milligram into the readily determinable range, has been a result of the increasing need for close chemical control of industrial processes. Rosin's book, based on Murray's "Standards and Methods of Testing of Reagent Chemicals," has been designed to bring up to date the various analytical test procedures and specifications required for accurate control work.

The book contains monographs on an exceptionally complete list of reagent chemicals, each including a purity specification and procedures for testing for impurities. More than one hundred substances are included which were not found in the last edition of Murray, the majority of these being organic compounds. About 70 per cent of the monographs include assays, and where possible, tests for physical constants such as optical rotatory power, melting point, specific gravity and volatility have been included. There is also a chapter on the preparation and standardization of

volumetric reagents, as well as a table of volumetric factors.

This is a book which should find a place on the reference shelf of every analytical laboratory.

ANALYSIS BY X-RAY

MATERIALPRUEFUNG MIT ROENTGEN-STRAHLEN. By *Richard Glocker*. Published by Julius Springer, Berlin. 382 pages. Price, RM 33.

Reviewed by *A. P. Hartlapp*.

THE AUTHOR presents the technology of the X-ray in the testing of materials. After the discovery that X-rays bend when passing through crystals, their electro-magnetic nature was definitely established by experimental work, and it has become possible to measure the wave-length of X-rays, and to study the atomic structure of crystals.

Certain characteristics of X-rays form the basis of material testing procedure:

(1) Absorption and absorption analysis, from which chemical composition, and microscopic failure can be established. The upper limit of use is in apparatus of voltages around 600 kv. In case it is necessary to employ rays of still greater penetration, the hard gamma rays of radium and mesothorium are used.

(2) Spectro-analysis. This serves to determine the chemical analysis of materials, qualitatively and quantitatively.

(3) Bending of X-rays in the atomic structure. This procedure will furnish proof of the atomic structure and position of the crystals in materials, a determination of the size of sub-microscopic crystals, as well as the possibility of measuring the elastic tension in materials.

While underlying physical theories have been properly mentioned, the author has put great emphasis upon the practical application of his procedure. It is believed that this book will be of special interest in the boiler making, high-pressure vessel building, welding, and electrical industries.

MODERN SOAP MAKING

DUE TO a misunderstanding, the price of Thomssen and Kemp's new book, *Modern Soap Making*, published by the MacNair-Dorland Co., was quoted on these pages last month as \$3 domestic and \$4 foreign. The correct price is \$7.50 domestic and \$8 foreign.

BRITISH PLASTICS YEAR BOOK, 1937. Published by Plastics Press Ltd., 19 Ludgate Hill, London, E.C.4. 602 pages. Price, 15 s.

WITH THE exception of a newly added, and rather limited, international "Who's Who in the Plastics Industry," the current edition of this directory is much the same as its predecessor, the

convenient sectionalized arrangement of contents being retained. The book remains essentially a buyer's guide to the British plastics and plastics-working equipment manufacturers and their products. It seems unfortunate, however, that some of the extraneous data included in the last section could not have been replaced by some conveniently presented and comparable data on the physical and chemical properties of the various commercial plastics or at least of the general plastic types such as phenolic, urea-formaldehyde, cellulose acetate, vinyl, etc.

AMERICAN GAS ASSOCIATION PROCEEDINGS 1936. Published by the Association, 420 Lexington Ave., New York City. 871 pages. Price, \$7 to non-members, \$3 to members.

ENGINEERING and economic contributions presented at the annual convention are here printed, together with a limited amount of discussion and supplementary material. The volume forms the most important collection of this type of literature published annually. It is an essential volume for every library which pretends to cover either public utilities, the fuel industries, or city gas.

FROM DRIVER TO DRIVEN

MECHANICAL POWER TRANSMISSION HANDBOOK. By *William Staniar*. Published by the McGraw-Hill Book Co., Inc., New York City. 488 pages. Price, \$5.

LONG and favorably known for his authoritative articles on mechanical power transmission appearing in *Chem. & Met.* and other periodicals, Mr. Staniar has now recorded the fundamentals of this subject in a book which will prove a necessity to every engineer who has to deal at any considerable length with the coupling of motivating to driven equipment. For a good many years Mechanical Power Engineer for the du Pont companies, the author is in an especially favorable position to discuss power transmission requirements as they relate to the chemical industry. Although the book is not thus limited, nevertheless, frequent recommendations which cover the severe requirements of the chemical plant are included, to the evident advantage of the chemical engineering reader.

Such a book might easily have degenerated into a purely descriptive compilation, useful as a catalog, but of little worth as a critical summary of the state of the art. As a matter of fact, such a criticism is by no means justified in this case. Necessarily there is not a little of the catalog in it, but at the same time Mr. Staniar's experience has been well crystallized, largely through the expedient of short, easily digested summaries of characteristics, advantages and uses, presented in outline form.

The object in preparing the present book has not been to supplant the several specialized books that are available covering certain branches of the subject. Rather it is intended as a compact and inclusive reference work and handbook, a function which in its 15 sections is realized in excellent fashion.

WATER POLLUTION REPORT. Published by the Water Pollution Research Board of the British Department of Scientific and Industrial Research. 56 pages. Price, 1 s. Purchasable from the British Library of Information, 270 Madison Ave., New York City.

THIS ANNUAL REPORT for the last fiscal year of the British Water Pollution Research Board summarizes numerous investigations of interest to American process industry. Among the topics treated in investigations now in progress or recently completed are: base-exchange processes of water softening and for removal of water contaminants; lead contamination of water; purification of sewage; milk factory effluents; activated sludge and colloid problems of sewage disposal; gas works effluent studies; and other general watershed protection methods.

ORGANIC SYNTHESSES, VOL. XVII. Edited by L. F. Fieser. Published by John Wiley & Sons, New York City. 112 pages. Price, \$1.75.

THE VOLUMES of *Organic Syntheses* need little introduction to the chemical public. The present collection of proven synthetic methods leans somewhat toward the biochemical interests of its editor-in-chief, listing as it does preparations such as of cholestanone and dehydrocholesterol. As a whole the book will be of greater direct value to the workers in pure research and to makers of fine chemicals than to the general industrial research chemist. The latter may find useful the directions for constructing various equipment such as the cracking unit for making butadiene.

DIRECTORY OF NEW ENGLAND MANUFACTURERS. Published by George D. Hall, Inc., Boston, Mass. 724 pages. Price, \$15.

NEW ENGLAND manufacturing companies from the largest to the smallest, along with their products, location of plants and offices, capitalization, number of employees and names of chief officers, are listed in this directory. The material is classified according to four different methods—name of company, geographical location, kind of products, and trade names of products, each of the four sections being printed on different colored paper. Included within the directory's New England boundaries are the states of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

World Chemical Developments in 1936, by C. C. Concannon and A. H. Swift. Bureau of Foreign and Domestic Commerce Trade Promotion Series 169; 30 cents.

The Physiological Response of Peritoneal Tissue to Certain Industrial and Pure Mineral Dusts, by John W. Miller and R. R. Sayers. Public Health Service Reprint 1787; 10 cents.

Chemical Nitrogen. Tariff Commission Report No. 114, 2nd Series; 25 cents. A survey of processes, organization, and international trade, stressing factors essential to tariff consideration.

Standard Agreement in the Textile Dyeing and Finishing Industry. Bureau of Labor Statistics Serial No. R. 457.

Discussion of Industrial Accidents and Diseases, 1936, Convention of the International Association of Industrial Accident Boards and Commissions, Topeka, Kansas. Division of Labor Standards, Bulletin No. 10; 20 cents.

List of American Doctoral Dissertations Printed in 1935. Library of Congress unnumbered document; 55 cents.

Census of Manufactures 1935 Summary by Industries. Bureau of the Census processed release June 9, 1937.

Summary Report of National Bureau of Standards Research on Preservation of Records, by A. E. Kimberly and B. W. Scribner. Bureau of Standards Miscellaneous Publication 154; 10 cents.

Abridged Volume Correction Table for Petroleum Oils. Supplement to Bureau of Standards Circular 410; 5 cents.

Solders and Soldering. Bureau of Standards Letter Circular 493; mimeographed.

Naval Stores Report 1936-37. Bureau of Chemistry & Soils; mimeographed. Production, distribution, consumption and stocks of turpentine and rosin of the U. S. by crop years.

Blast-Furnace Processes for the Production of Phosphatic and Potassic Fertilizer Materials. Department of Agriculture Technical Bulletin 543; mimeographed.

Western Hemlock Bark an Important Potential Tanning Material, by Chas. C. Smoot and Ralph W. Frey. Department of Agriculture Technical Bulletin 566; 10 cents.

Trace Elements in the Soils From the Erosion Experiment Stations, With Supplementary Data on Other Soils, by C. S. Slater and others. Department of Agriculture Technical Bulletin 552; 5 cents.

The Insecticidal Action of Acid Lead Arsenate on the Larvae of the Japanese Beetle in Different Types of Soil, by Walter E. Fleming and others. Reprint from Journal of Agricultural Research, vol. 53, No. 10, Nov. 15, 1936; 5 cents.

The Optical Rotatory Power of Extracts of Derris and Cube Roots, by Howard A. Jones. Reprint from Journal of Agricultural Research, vol. 53, No. 11, Dec. 1, 1936; 5 cents.

Diseases and Insects of Garden Vegetables. Department of Agriculture Farmers' Bulletin 1371; 10 cents.

Grade, Staple Length, and Tenderability of Cotton in the United States 1928-29 to 1934-35. Department of Agriculture Statistical Bulletin 56; 10 cents.

Recent Trend Toward Diversified Farming in Southern Cotton Areas, by Helen I. Slentz. Resettlement Administration, Land Use Planning Publication No. 17; mimeographed.

United States Census of Agriculture, 1935—Vol. III, General Report, Statistics by Subjects. Bureau of the Census; \$1.75

(Buckram) 415 pages. Includes data on commodity production as well as land population and related farm figures.

Diseases of Plants in the United States in 1935. Bureau of Plant Industry, Supplement 96 to The Plant Disease Reporter; mimeographed.

Table of Number of Packages Per Carload. Bureau of Agricultural Economics, February 1937; mimeographed.

Technology and the Mineral Industries. Joint booklet of Works Progress Administration and Bureau of Mines; processed.

Résumé of Works of the Nonmetals Division, Calendar Year 1936, by Oliver C. Ralston and A. George Stern. Bureau of Mines Information Circular 6934; mimeographed.

Calculation of the Specific Heats and Entropies of Metal Vapors from Spectroscopic Data, with special reference to gaseous iron and copper, by K. K. Kelley. Bureau of Mines Report of Investigations 3341; mimeographed.

Occurrence, Properties, and Preparation of Limestone and Chalk for Whiting, by Hewitt Wilson and Kenneth G. Skinner. Bureau of Mines Bulletin 395; 30 cents.

Mineral Production Statistics for 1936—preliminary mimeographed statements from Bureau of Mines on: magnesium; liquefied petroleum gases; barite and barium; consumption of ferrous scrap and pig iron; lead-fluorspar; phosphate rock; mercury; sand and gravel; carbon black; abrasive materials; iron ore; pig iron and ferro-alloys; molybdenum; platinum; manganese ore; salt; lead and zinc pigments and zinc salts.

Summary of United States Trade With World, 1936. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 837; 5 cents.

Analyses of Rocks and Minerals From the Laboratory of the United States Geological Survey 1914-36. Geological Survey Bulletin 878; 15 cents.

Physical Properties of Materials. Bureau of Standards Circular 101 and Supplement; 40 cents for the two. This is a reprint with additions and supplement of the reference document which gives strengths and related properties of metals and wood. The original second edition appeared in 1924.

Fixation of Sulphur from Smelter Smoke. Metallurgical Division Progress Report No. 17, which includes: Present Status of Sulphur Fixation and Plan of Investigations, by R. S. Dean; Vapor Pressure and Thermodynamic Properties of Ammonium Sulphites, by Hillary W. St. Clair; Recovery of Sulphur in Solid Compounds by the Addition of Ammonia and Water Vapor to Smelter Gas, by G. W. Marks and P. M. Ambrose; Diethylene Triamine and Other Amines as Agents for the Recovery of Sulphur Dioxide, by G. W. Marks and P. M. Ambrose; and Oxidation of Ammonium Sulphite Solution, by Frank S. Wartman. Bureau of Mines Report of Investigations 3339; mimeographed.

Studies in the Metallurgy of Copper. Metallurgical Division Progress Report No. 18, which includes: Distribution of Manganese Between Matte and Slag in the Smelting of Copper, by F. S. Wartman, G. M. Potter, and M. D. Schmid; Graphic Representation of the Ratio of Manganese Distribution Between Matte and Slag, by Merle D. Schmid; Experiments in the Flash-Reasting of Copper Concentrates, by F. S. Wartman and others. Bureau of Mines Report of Investigations 3340; mimeographed.

Chloride Volatilization of Lithium From Spodumene, by Foster Fraas and Oliver C. Ralston. Bureau of Mines Report of Investigations 3344; mimeographed.

Synthetic Organic Chemicals, 1936. Mimeographed preliminary statement of production and sales of coal-tar crudes, dyes, and other synthetics. U. S. Tariff Commission release, June 24, 1937. Printed document will appear giving these and supplementary data later in the summer.

Report of Work of the Mining Division, U. S. Bureau of Mines for Calendar Year 1936, and Program for 1937, by Chas. F. Jackson. Bureau of Mines Information Circular 6939; mimeographed.

Curves for the Classification of Coal, by J. F. Barkley and L. R. Burdick. Bureau of Mines Information Circular 6933; mimeographed.

Extraction Methods for Determining Tar Acids and Bases, and Variables Affecting Their Accuracy, by C. H. Fisher and Abner Eisner. Bureau of Mines Report of Investigations 3310; mimeographed.

Estimate of Natural-Gas Reserves From the Layton, Oolitic, and Oswego-Prue Horizons in the Oklahoma City Oil Field, by R. E. Heithecker. Bureau of Mines Report of Investigations 3338; mimeographed.

Mining and Milling Methods and Costs at the Glass-Sand Plant of P. J. Weisel, Inc., Corona, Calif., by Edmund Shaw. Bureau of Mines Information Circular 6937; mimeographed.

Navy Specifications. New or revised specifications of the Navy Department on: Glass, fibrous, insulating, 32G2a; Glue, marine (ship), 52G6c; Grease, lubricating, mineral, 14G1g; Lubricant, ball- and roller-bearing, 14L3b; Lubricant, gear, 14L4; Lubricant, waterproof, 14L5; Oil, fuel, 7-O-1e; Oil, fuel, Diesel, 7-O-2c; Soap, olive oil-soda (Castile), 51S3d; Phenolic-material, molded, 17P4; Cellulose-acetate (or similar material), flame-resisting, transparent, sheet, 33C3b; Duck, cotton, bleached, 27D6a; Packing, carbon, 33P18b; Compound, rust-preventive, 14C4b; The above specifications are available from the Bureau of Supplies and Accounts, Navy Department.

Federal Specifications. New or revised specifications of the Federal Specifications Board on: Cement, Portland, SS-C-191a; Cement, Portland, high-early-strength, SS-C-201; Cement, Portland, sulphate-resisting, SS-C-211; 5 cents each.

Mineral production statistics for 1936—preliminary mimeographed statements from Bureau of Mines on: Magnesite; asbestos; pyrites; potash; rolled zinc; zinc; masonry, natural, and puzzolan cement; aluminum salts; bauxite.

British Factory Inspection. Department of Labor, Division of Labor Standards Bulletin No. 11; 10 cents.

American Standard Specifications For Dry Cells and Batteries. Bureau of Standards Circular 414; 5 cents.

Business Census Publications. Bureau of the Census unnumbered pamphlet; mimeographed.

Foreign Commerce Yearbook, 1936. Bureau of Foreign and Domestic Commerce unnumbered book; \$1.25 (Buckram). Basic statistical material to show current economic developments in foreign countries.

List of Available Publications of the U. S. Department of Agriculture, January 2, 1937. Department of Agriculture Miscellaneous Publication No. 60.

Selected Trade Associations of the United States: 1937 Edition. Bureau of Foreign and Domestic Commerce Market Research Series No. 1; 10 cents; mimeographed.

Tests of the Compressibility and Bearing Strength of Potash Salt, by H. P. Greenwald and others. Bureau of Mines Technical Paper 575; 10 cents.

Italy's Ability to Produce and Capacity to Consume Mineral Raw Materials in 1936, With Comments Concerning Government Assistance to Mining Industries, by Charles Will Wright. Bureau of Mines, Special Supplement No. 6 to Mineral Trade Notes, March 20, 1937; mimeographed.

Present Situation in the Nonferrous Metal Industries in Poland, by Charles Will Wright. Bureau of Mines, Special Supplement No. 7 to Mineral Trade Notes, April 20, 1937; mimeographed.

Resume of Research and Technologic Work Relating to Coal Conducted by the Technologic Branch During 1936, by Arno C. Fieldner. Bureau of Mines Information Circular 6935; mimeographed.

Timesaver for Multi-Floored Plants

IN THE REFINERY and distillery of the Pennsylvania Sugar Co., at Philadelphia, are seven between-floors manlifts which in their 13 years of operation have traveled a total estimated distance of 660,000 miles and carried an estimated 13,000,000 riders. Nobody has attempted to estimate the time they have saved, but the total must be almost astronomical.

Manlifts are no novelty in the West, although in the East, and particularly in chemical plants, they are not well known. This may in part be due to their having occasionally been proscribed by law, but the safety record of the Pennsylvania installations is so enviable that the possibility of danger should be no deterrent where legal bars do not exist. Safe use presupposes a certain amount of intelligence and new employees at the refinery are given instruction in use of the lifts and in their safety features. Visitors are not ordinarily invited to ride. With these precautions, very few accidents have occurred, and those only owing to inattentiveness or actual recklessness.

The longest of the seven manlifts is

114 ft. 8 in. between centers of the head and tail pulleys, while the shortest spans 65 ft. The average cost of all the lifts has been about \$2,500 each, installed in an existing building. In a new building with proper framing provided, the cost would probably be somewhat lower.

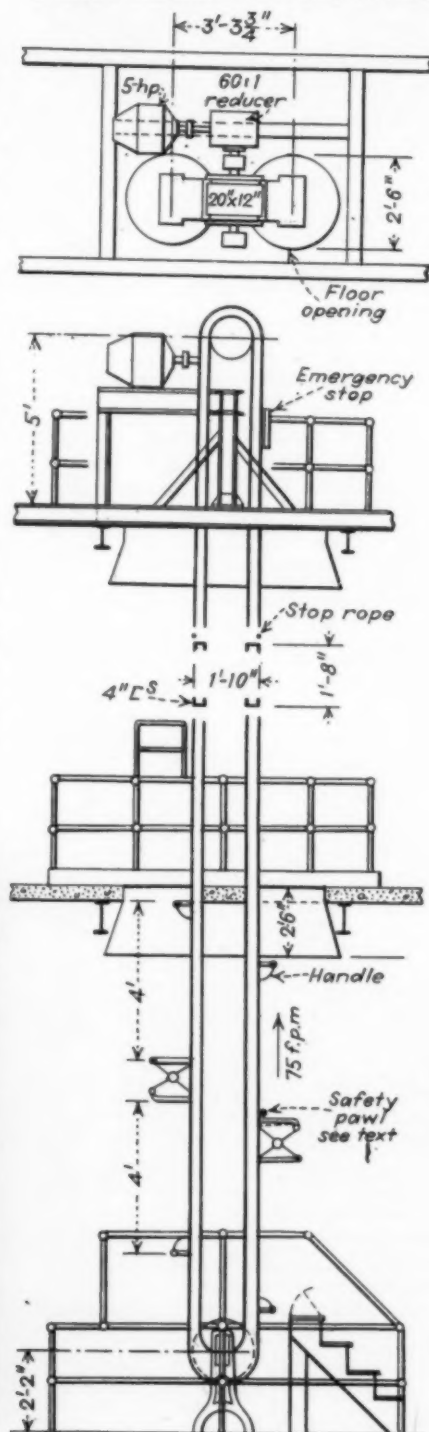
In describing the construction of the lifts, we cannot do better than to quote excerpts from the company's engineering log, which is kept by Dan Gutleben, Chief Engineer.

"The first manlift was furnished by an outside concern and started in the melter house in 1924. Our athletic Polanders jumped on to the steps with such vigor that the castings could not resist. Since the builders hesitated to change their standards, we made our own patterns and built our own machines, installing the highest grade of Cleveland worm gears for the head shafts, using an exaggerated factor of safety. The belts are Goodyear 6-ply 36 oz. duck, Style F.S., friction surface elevator belting without rubber covers, except in the alcohol plant where, because of an occasional spill of liquid that might affect the unprotected duck,

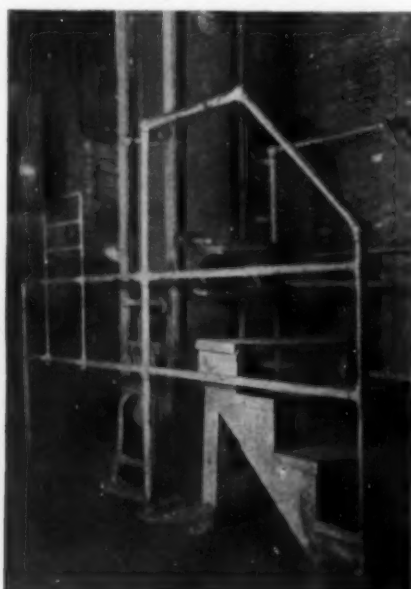
rubber covering is used on both sides. This belt at first generated static electricity, an unhealthy condition in an alcohol plant! Grounding the frame did not stop the sparks. The Master Mechanic decided the belt was stretched too tight. When he eased up on the stretch, the static disappeared.

"In the interests of safety, certain special features have been applied, to wit:

Plan and elevation of manlift showing principal dimensions and safety features



Top and bottom views of one of the manlifts in the Pennsylvania Sugar Co. refinery



"1. The foot shaft is about 3 ft. above the bottom floor. The up-going passenger reaches the step by means of a short stair, the top tread of which is hinged. The downward traveling passenger cannot forget to get off at the bottom and run the risk of getting caught in a pit in case of absent-mindedness.

"2. The head shaft is located about 5 ft. above the top landing. In case the automatic stop should fail, the absent-minded passenger will receive a reminder to get off when his hand begins to ride over the head pulley. Ordinarily, however, if the passenger is not off the step by the time it has reached a foot above the top landing, the machine will stop dead. This is accomplished by a trigger which projects out from the step beyond the guide as soon as the step is loaded. A foot above the top floor this trigger engages a lever which stops the motor and throws on a brake.

"3. Funnel shaped hoods are installed under each ceiling as a fire stop as well as a safety guide in case some thoughtless youngster should lean away from the belt.

"4. The handles are provided with shrouds so that the passenger will not be tempted to hang on to the wrong handle. There is a handle respectively 4 ft. above and below each step, one for going up, one for coming down. Before the handles were protected with shrouds, the men occasionally hung on to a handle below the step.

"5. A safety rope is provided on each side so that the rider may stop the machine instantly by pulling on the rope.

"The machines never stop except for cleaning or repair. The guide rollers at the steps are made of bronze to reduce wear. Occasionally a cast-iron step bracket fails because of the savage

treatment of some of our 'elephants.' As these fail they are replaced with steel. The belt in the char house where the temperature is high was replaced after seven years' service. In the melter

house the belt served ten years, carried thousands of men and, traveling at the rate of 75 ft. per minute or 20 miles per day, moved 73,000 miles during this period."

AMMONIA IN PETROLEUM REFINING

By E. R. WOODWARD
Chemical Engineer
New York, N. Y.

EXPERIENCE in the application of anhydrous ammonia for corrosion prevention in actual refining practice suggests that the following data will be welcomed by refinery engineers who plan to make the installation.

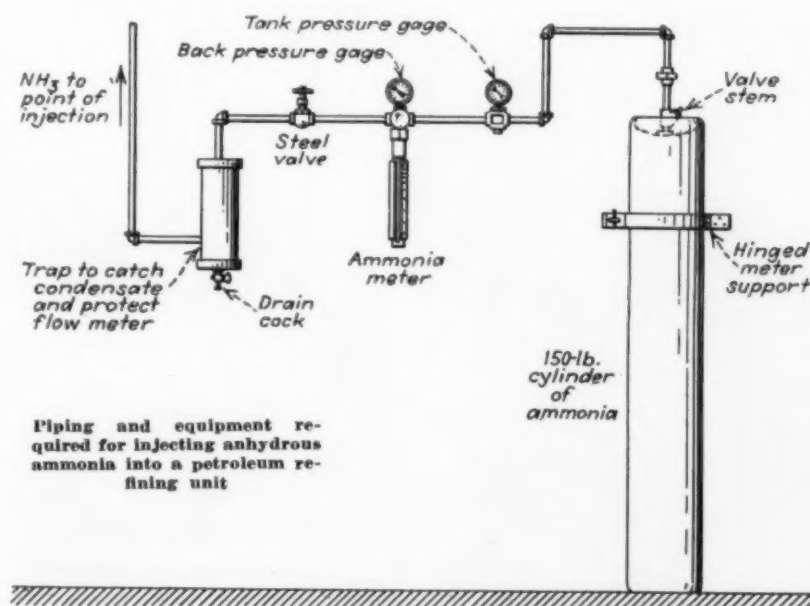
Anhydrous ammonia in cylinders is in liquid form under pressure, and the vapor pressure of the ammonia gas above the liquid in the cylinder is dependent upon the temperature of the liquid ammonia. Thus, for example, when the liquid ammonia has a temperature of 70 deg. F., the vapor pressure is 128.8 lb. per square inch absolute, or about 114 lb. gage. At 30 deg. F., the vapor pressure is 59.74 lb. absolute, or 45 lb. gage. This gives ample pressure to feed the ammonia gas into a bubble tower, or into a vapor line in an atmospheric unit.

In cracking units where the back pressure from the tower or the gasoline vapor line reaches 60 lb. or more, the additional vapor pressure may be generated by submerging the ammonia cylinder in a water bath heated with exhaust steam. The vapor pressure of ammonia at 90 deg. F. is 180.7 lb. absolute, or 166 lb. gage. Ammonia cylinders are tested to 1,000 lb. per square inch when new. However, a cylinder of ammonia must never be

heated with a direct flame, or placed near boilers. The critical temperature of ammonia is 270 deg. F., corresponding to a critical pressure of 1,642 lb. gage. It is, of course, hazardous to heat cylinders of ammonia to a point at which the resulting pressure approaches the limits for which the cylinders are constructed.

In oil refinery practice, when the cylinder has been connected and actual injection of the ammonia has begun, everything may run smoothly until the cylinder is empty and has to be replaced, or for some reason the ammonia is shut off temporarily. The condition then existing in the ammonia piping between the cylinder and the unit is such that instead of an upward pressure of 114 lb. per square inch gage there is a back pressure of a few pounds from the unit itself, and it is quite likely that condensed water and gasoline will run back through the ammonia line, flooding out the liquid from the manometer of the flow meter. This would make it necessary to dismantle the meter, clean it, and replace the manometer liquid before being able to renew the ammonia feed. Of course, the thought that comes immediately to the practical man's mind is: "Well, put a check valve in the line!" Quite right, but check valves have an unfortunate way of leaking, and it is possible for enough condensate to get past a check valve to flood out the meter and displace the manometer liquid.

The best way to make the connection of ammonia cylinder to equipment is shown in the drawing. The $\frac{1}{2}$ -in. ammonia line running down from the tower or vapor line is connected to the bottom of a trap, from the top of which it goes on through the flow meter to the cylinder. When the cylinder becomes empty, or if it is desired to shut off the cylinder valve, the drain-cock at the bottom of the trap should be opened, and the steel valve between the trap and the meter should be shut. In this way any condensate which may flow back from the unit will be drained off, and the ammonia flow meter will be protected from flooding. To prevent escape of petroleum gases through the open drain-cock, it should be closed after the condensate has been drained from the ammonia line.



Machinery, Materials and Products

Electric Recirculating Dryer

ELECTRIC AIRHEATER Co., a division of the American Foundry Equipment Co., 555 Byrkit St., Mishawaka, Ind., has introduced a new type of electrically operated recirculating dryer known as the Electromode. With these dryers, temperatures up to 400 deg. F. are obtained by means of recirculation, while it is stated that constant heat within 2 deg. of any desired temperature can be maintained by means of automatic thermostatic control. A housing 6 ft. x 16 in. x 15 in. contains all the heating and circulating mechanism and can be bolted on to the drying room or chamber. The elements are of cast aluminum construction, heating being accomplished by means of a Calrod around which an aluminum grid is poured. These elements are said to require only one minute to attain full heat. The dryer is completely insulated throughout and, having no exposed hot wires or glow elements, is said to be entirely safe from explosions or fires.

Metal Conveyor Belt

ACME STEEL Co., Chicago, Ill., has announced a new metal conveyor belt made from galvanized or stainless strip steel, consisting of individual flat surfaced links, joined by spindle wires. The wires have a self-locking feature with ends protected by flanges on the underside of the belt. The belt is flexible and can be drawn over small or large pulleys. Ridges on the underside provide a continuous level surface for the idler rolls. The belt will not stretch and is said to be easily cleaned. Widths are in multiples of 1 in. to fit all sizes of conveying equipment. Both solid and perforated belts are available.

Motorized Blower

TYPE CS is the designation of a new motorblower for delivering air at a pressure of 1 lb. gage and in capacities from 325 to 3,200 cu.ft. per min., recently announced by the Ingersoll-Rand Co., 11 Broadway, New York City. The new design is stated to be especially adapted to the job of supplying air to

furnaces at constant pressure. The design is such that the pressure remains practically constant regardless of the volume being delivered. Through the use of internal streamlining to reduce turbulence to a minimum, the new blowers consume power almost exactly in proportion to the volume of air handled. Motors are supplied in ample size to carry the rated load without exceeding suitable continuous overload capacity.

Electric Flow Meter

SEVERAL new features are found in the electrically operated flow meter known as the Synchro-Meter, which has recently been announced by the Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland, Ohio. The measuring device is a Ledoux bell flow meter of the type used in standard Bailey mechanically operated units. The receiver, consisting of the indicating, recording and integrating mechanisms, is situated at some point remote from the measuring device, and the two are linked by an electrical system. Three wires are required for the connection. The only limitation on distance is that the loop resistance shall not exceed 20 ohms.

A diagrammatic representation of the electric hook up is shown in the accompanying drawing. In the transmitter are two movable contact arms

Medium pressure blower



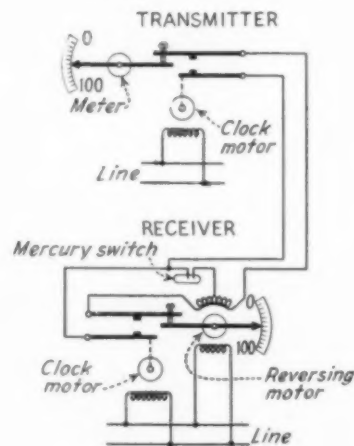
and a constant speed cam which moves the lower arm continuously. The upper is positioned by the flow measuring device. In the receiver a similar construction is used except that the upper contact arm is positioned by a reversing induction motor. This motor is provided with shading coils, either of which can be short circuited to run the motor in one direction, or the other. When both are short circuited, no rotation results.

The transmitter contacts are connected to short circuit one coil when the mercury switch is closed, while the receiver contacts short circuit the other. When transmitter and receiver are in exact relation, both contacts close together and no rotation of the motor results. If the rate of flow decreases, the transmitter contacts will be closer together and so close first, causing rotation in one direction, while with increasing flow, rotation of the motor takes place in the other direction, positioning the receiver to show a higher meter reading. The mercury switch is provided to open the circuit before the transmitter and receiver contacts can open, thus saving them from sparking.

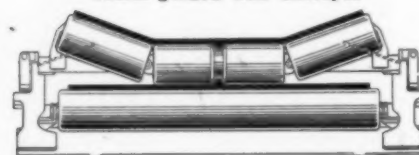
Self-Guiding Belt

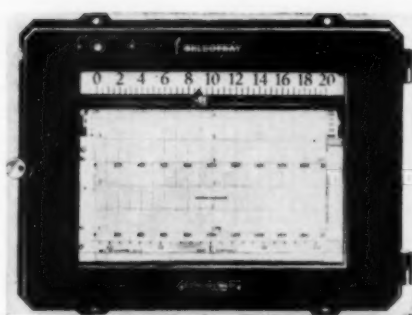
FOR USE in long belt conveyor runs the Link-Belt Co., 307 North Michigan Ave., Chicago, Ill., has developed a new center-guided belt conveyor, the distinctive feature of which is the use on the under side of the belt of a continuous central guide-strip molded into the structure of the belt. Corresponding with this is a deep groove in the center roller of the anti-friction con-

Schematic hook up of electric flow meter mechanism

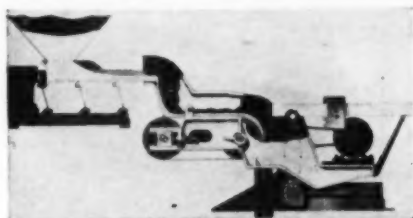


Center-guided belt conveyor





High speed potentiometer



Precision electric weighing machine

veyor idlers which confines the guide strip on both going and return runs of the conveyor.

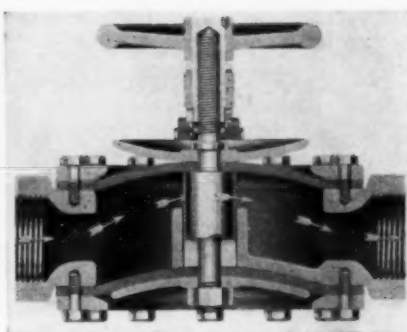
According to the manufacturers actual tests have shown that the guide strip is effective even when the belt is considerably tilted to one side. Hence it is claimed that the life of such a belt is materially longer than that of a comparable belt which would be subject to edge wear.

The new conveyor construction can be supplied for any width of belt, double guide strips being used for the wider belts. The new belts have been given the name of Philips Brand, after their inventor.

High Speed Potentiometer

PHOTOELECTRIC balancing is employed in a new high speed potentiometer recently announced under the name of Celestray by the C. J. Tagliabue Mfg. Co., Park and Nostrand Aves., Brooklyn, N. Y. A sensitive mirror galvanometer is used as the primary controlling element. The beam of light from the galvanometer, in moving on and off a phototube, passes the "controlling edge" of a screen, thus operating relays which in turn control a reversing motor. The motor drives the moving contact of the potentiometer to establish balance.

Since the phototube is not a calibrated element, but serves only to detect the direction of the light beam and bring the galvanometer to zero deflection, and since the galvanometer is at all times free from mechanical engagement, the new instrument is said to be of exceptional accuracy. Further, it is said to be much simpler than earlier equipment of this type.



Cross section of balanced diaphragm valve

Weighing Machine

A PRECISION weighing machine said to be applicable to continuous weighing, proportioning and batching has been announced by the Jeffrey Mfg. Co., Columbus, Ohio. It has been given the name of Waytrol and combines an electric vibrating feeder, a synchronous weight belt on a scale beam so pivoted as to receive material at the more sensitive end, and automatic electric control. Feeding and weighing are physically separated operations, the weigh belt traveling at constant speed and the feeder, through the automatic electric control, making instant corrections in delivery as soon as the weighing mechanism can detect any departure from the set rate.

Waytrols are built in sizes handling from a few pounds to many tons per hour. All sizes are stated to be accurate within at least 1 per cent.

Balanced Diaphragm Valve

A NEW TYPE of diaphragm valve, featuring balanced construction, has been announced by the McAlear Mfg. Co., Chicago, Ill. It is stated that the valve will close tightly under repeated service on fluids containing foreign matter. It is without packing or stuffing boxes and so balanced that opening and closing are claimed to be easy, while it is stated that in throttling service, no bad effects will be experienced with wire drawing.

Special diaphragm compositions are available to take care of such materials as air, water, gas, acids and alkalis, while suitable body materials can likewise be supplied. The valve is stated to operate equally well in any position, while it need not be removed from the line for changing diaphragms. It is made in sizes of 2 in. and larger.

Improved Brine Tank

FOR THE SUPPLY of brine at constant temperature to batch processes, the Carbondale Division of Worthington Pump & Machinery Corp., Harrison, N. J., has developed a special type of brine storage tank intended to take care of peak load

refrigeration processes in chemical plants, breweries, etc.

The tank is divided into five compartments. At the start of the cooling operation, four of the compartments are filled with cold brine while the fifth is used to receive the warmer brine returned from the process. In the usual method of brine storage, the warmer brine returns to the same tank and mixes with the colder brine so that at the end of the operation, brine going to the process is much warmer than at the beginning. With the new tank, as each compartment in turn is emptied, brine is withdrawn from a new compartment, returning always to the last and overflowing to those previously emptied. Eventually, when the process is completed, the brine can be recooled over a relatively long period by means of the refrigerating machine.

Recording Meter

A NEW RECORDING potentiometer of the round chart type, known as the Pyromaster, has been developed by the Bristol Co., Waterbury, Conn. This recording potentiometer is available as a pyrometer, tachometer, resistance thermometer, millivoltmeter or milliammeter.

The meter requires no lubrication and is said not to be affected by normal plant vibration or dusty, moist or corrosive atmospheres. Its operating mechanism is made up in five small, compact units which are replaceable. There is no mechanical connection between the galvanometer and the other units. The pen is actuated in such a way as to follow changes in the measured quantity as they occur and at a rate dependent upon the rate of change.

Equipment Briefs

FUEL RATIONMETER is the name given to a new electric meter for the measurement of carbon dioxide content and stack temperature, recently introduced by the Wm. O. Hebler Co., 830 Broad St., Newark, N. J. The new instrument is compact and portable, requiring for its use no equipment other than that contained in the case. It operates on the well-known thermal conductivity principle with two arms of the Wheatstone bridge placed in a standard cell surrounded by air, and the other two in the analyzing cell which is open to the flow of gas. A thermocouple is provided for measuring stack temperature.

SAID TO BE a practical substitute for riveting, the "Structural Rib Bolt" has recently been announced by the Automatic Nut Co., Lebanon, Pa. The shank of the bolt carries triangular shaped ribs which imbed themselves in the wall of the hole in the work. A standard button head is employed. When assembled with

the special variety of lock nut made by this company, it is stated that the assembly is permanently tight, although the nut can readily be unscrewed with a wrench. Owing to the ease of installation, substantial savings are said to result, especially in the case of field erection.

SIMPLICITY in use is an outstanding characteristic of the new American Heatproof detachable coupling for use with the seamless flexible metal tubing made by the American Brass Co., 25 Broadway, New York City. The coupling is said to be extremely strong, to have no rustable parts and to be capable of detachment and reattachment as often as desired. Its three parts grasp both the corrugated tube and the woven metal cover.

NEW SIZES, 1½, 1¼ and 2 in., have been added by the Hancock Valve Division of Consolidated Ashcroft Hancock Co., Bridgeport, Conn., thus completing the line of bronze Hancock valves. Sizes 1 in. and smaller were previously available. The new valve, made in both globe and angle patterns, features a conical seat and disk of exceptionally hard stainless steel, heat-treated to a hardness of 500 Brinell. The manufacturers claim that the mating parts of the valve are so hard as to be able to mash boiler scale, sand or even nails without leaving a mark on either seat or disk.

HYDRAULIC CONTROL for its Varidrive motor has recently been developed and announced by U. S. Electrical Motors, Inc., Los Angeles, Calif. The control mechanism can be placed at a remote location and the speed regulated smoothly in an infinite number of steps. Only a single small tube between the control mechanism and the motor is necessary.

USE of copper oxide plate type rectifiers for electroplating is now possible owing to the development of such equipment by the Hanson-Van Winkle-Munning Co., Matawan, N. J., in connection with the Westinghouse Electric & Manufacturing Co. Numerous sizes are available, providing a wide range of direct current supply. The unit consists of power transformers, a small fan for air circulation and the rectifier unit and necessary control equipment. Properly installed, such a rectifier is said to have extremely long life and low maintenance cost.

FOR SHOCKLESS hydraulic pressures up to 6,000 lb., the Atlas Valve Co., 282 South St., Newark, N. J., has developed a new forged steel reducing valve designated as Type E. Internal metal parts are entirely of stainless steel and a formed packing said to be superior to

leather is provided. The valve is recommended for use with water, oil and air.

REDESIGN of its entire line of Typhoon portable power mixers has been announced by the Patterson Foundry & Machine Co., East Liverpool, Ohio. An important feature is reduction in weight which, in the ½-hp. size, for example, amounts to 10 lb. Aluminum has been used extensively in the construction, together with chromium plate finish. No paint is used in finishing any of these new models.

A **BULB-TYPE** pump for withdrawing acids or other corrosive liquids from carboys and similar containers is being marketed by the Lea Mfg. Co., Waterbury, Conn. The pump is said to operate faster than a syphon, having a normal capacity of 2 g.p.m. but being capable of higher capacity with more rapid manipulation of the bulb. A relief valve is opened to vent the unused pressure. Noxious or dangerous fumes cannot escape, according to the manufacturer.

SUCH MATERIALS of construction as stainless steel, pure nickel, Monel metal, Everdur, acid bronze, lead and aluminum are used in building a new single-suction centrifugal pump for corrosive liquids recently announced by the Lawrence Pump & Engine Co., Box 70, Lawrence, Mass. Ball bearing construction, extra deep stuffing boxes, and a vertical split casing are important construction features. The design is said to be adaptable to a wide variety of individual requirements in the handling of acids, alkalis, oils or almost any other liquid.

GREATER TENSILE strength, hardness and resistance to corrosion than is obtainable in either forged steel or malleable iron unions is claimed for the new Dualsteel union recently announced by the Rockwood Sprinkler Co., 38 Harlow St., Worcester, Mass. This union is recommended for 600 lb. working steam pressure or 1,000 lb. hydrostatic pressure, and 900 deg. F. The union is completely Parkerized, the coating not only assisting in preventing corrosion, but also acting as a thread lubricant. Tests are stated to have shown superior corrosion resistance compared with other union materials against dilute mineral and organic acids, as well as salt spray. Sizes ¼ to 2 in. are available.

HEAVY WALL THICKNESSES, deep stuffing boxes, oversized stems, and steel hand wheels with fluted non-slip rims, are important features of a new line of steel gate valves recently introduced by the Walworth Co., New York City. These valves are made in 150 lb. and 300 lb. steam pressure ratings, from a carbon molybdenum steel following A.S.T.M. Specification A 157-36.

FOR USE with belt conveyors handling heavy lumps, with the consequent likelihood of heavy impact, the Stephens-Adamson Mfg. Co., Aurora, Ill., has introduced a new solid rubber roll belt carrier. The rolls consist of a 1½ in. covering of vulcanized rubber vulcanized to a 2½-in. diameter pressed steel hub. In addition to the increase in life of the carrier under heavy wear which this construction is said to provide, it is also claimed to add largely to the life of the belt because of the cushioning effect.

MANUFACTURERS' LATEST PUBLICATIONS

Alloys. Peter A. Frasse & Co., 17 Grand St., New York City—New booklet listing prices on stainless steel specialties such as nuts, screws, bolts, pipe fittings and so on.

Alloys. Revere Copper & Brass, Inc., 230 Park Ave., New York City—Leaflet listing chemical and physical properties of a considerable range of alloys made by this company.

Alloys. Vanadium Corp. of America, 420 Lexington Ave., New York City—Handsomely printed book of 180 pages presenting authentic and concise information concerning the properties of ferrous alloys containing vanadium; also numerous applications.

Bearings. The Fast Bearing Co., Hampden Ave. and 23d St., Baltimore, Md.—16-page catalog describing characteristics and principles of this company's oil film bearings for industrial purposes, including engineering information on selection, installation and operation.

Cements. Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia, Pa.—Pamphlet 3—8 pages describing Asplit acidproof cement with information on its resistance and uses.

Cements. Sauereisen Cements Co., Sharpsburg Station, Pittsburgh, Pa.—Engineer's Manual 36—62 pages covering 33 varieties of industrial and technical cements and compounds for a wide variety of acid and heat resisting applications.

Controls. Mercoild Corp., 4201 Belmont Ave., Chicago, Ill.—16-page spiral bound bulletin briefly describing this company's automatic controls for heating installations.

Copper. United States Metals Refining Co., Oxygen-Free Copper Dept., 420 Lexington Ave., New York City—7-page reprint of an article by Edwin F. Cone, describing the manufacture of oxygen-free high conductivity copper.

Dust Collection. Claude B. Schneible Co., 3951 Lawrence Ave., Chicago, Ill.—4-page bulletin describing this company's new Multi-Louver dewatering tank for use in Schneible wet type dust collectors.

Dust Collectors. Northern Blower Co., 6409 Barberton Ave., Cleveland, Ohio—Bulletin 500-2—4 pages of descriptive material, with engineering data on this company's round type air filters.

Electrical Equipment. Acme Electric

& Mfg. Co., 1440 Hamilton Ave., Cleveland, Ohio—Bulletin 142—4 pages describing this company's transformers for high intensity mercury vapor lamps.

Electrical Equipment. Century Electric Co., 1806 Pine St., St. Louis, Mo.—Forms 1032 and 1033—Each 8 pages covering respectively slip-ring motors in sizes from 1 to 350 hp. and direct current motors from 1 to 300 hp.

Electrical Equipment. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—Catalog Section 43-600—10 pages describing a new line of detachable instruments for outdoor and indoor service.

Equipment. The Dorr Co., Inc., 570 Lexington Ave., New York City—Bulletin 3071—9 pages describing this company's washing thickeners, showing typical flow-sheets and operating information.

Equipment. The Duriron Co., Dayton, Ohio—General Catalog 1937-38—12 pages describing and giving properties of the corrosion resisting alloys made by this company and illustrating and briefly describing a wide range of equipment made from these alloys.

Equipment. Peerless Equipment Division, Emerson-Scheuring Tank Co., Indianapolis, Ind.—33-page catalog, describing this company's steam jacketed equipment for the handling of viscous materials, listing sizes, prices and engineering data. Covers piping, valves, pumps and kettles.

Equipment. F. J. Stokes Machine Co., Philadelphia, Pa.—4 pages describing this company's 80-ton Stokes-Standard preforming press for production of preforms of molding materials.

Filters. The Elmco Corp., Salt Lake City, Utah—Bulletin 401—22 pages describing and showing applications of this company's continuous drum and disk vacuum filters.

Furnaces. W. S. Rockwell Co., 50 Church St., New York City—Bulletin 369—8 pages illustrating a wide range of fuel and electric industrial furnaces made and installed by this company.

Gas Cleaning. Western Precipitation Corp., Los Angeles, Calif.—Technical bulletin describing methods for determination of velocity, volume, dust and mist content of gases.

Instruments. Cambridge Instrument Co., Ltd., 45 Grosvenor Place, London, S.W.1, England—Folder 47a—6 pages describing this company's pressure and draft indicators and recorders.

Instruments. Hellige, Inc., 3718 Northern Blvd., Long Island City, N. Y.—Leaflet describing this company's apparatus for electrometric pH control with glass electrodes.

Instruments. Thwing-Albert Inst. Co., 3339 Lancaster Ave., Philadelphia, Pa.—Bulletin M-361-A—4 pages on the measurement of pH and a description of this company's equipment for the purpose.

Insulation. Johns-Manville, 22 East 40th St., New York City—4-page leaflet showing typical applications of this company's JM-20 insulating brick in the insulation of industrial furnaces, including tables on heat loss.

Insulation. Quigley Co., 56 West 45th St., New York City—Bulletin 326 and 327—Leaflets describing respectively Insuloblox and Insulag, lightweight refractory block insulation and refractory lagging made from Insuline.

Insulation. Refractory & Insulation Corp., 381 Fourth Ave., New York City—6-page bulletin describing Stic-Tite plastic insulation for the heat insulation of surfaces at temperatures up to 1,800 deg. F.

Lubrication. Bijur Lubricating Corp., Long Island City, N. Y.—Bulletin D—16 pages describing in detail this company's centralized automatic lubrication system.

Lubrication. Shell Petroleum Corp., Shell Building, St. Louis, Mo.—25-page booklet, Vol. 1 No. 1 of a series entitled "Panorama of Lubrication," describing in simple non-technical fashion the fundamentals of lubrication.

Magnetic Equipment. Stearns Magnetic Mfg. Co., Milwaukee, Wis.—Bulletin 690—Describes this company's new style DM magnetically operated brake. Also bulletin describing various types of suspended and hand magnets.

Materials Handling. Baldwin-Duckworth Chain Corp., Springfield, Mass.—"Dossier A-2"—Second installment of this company's amusing series on the adventures of A. Balduck, the Engineering Detective, who this time solves an interesting power transmission problem in a stoker installation.

Materials Handling. Barber-Greene Co., Aurora, Ill.—116-page catalog, covering this company's standardized belt conveyors, both portable and permanent. Also covers stackers.

Materials Handling. Cleveland Crane & Engineering Co., Wickliffe, Ohio—Form G337—6 pages describing hand-propelled carriers with motor operated hoists for a wide variety of materials handling applications.

Materials Handling. Lewis-Shepard Co., 270 Walnut St., Watertown Station, Boston, Mass.—Circular 146—4 pages describing a wide variety of skid platforms for use with lift trucks.

Nozzles. Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.—Bulletin N-615—4 pages describing involute spray nozzles for air conditioning and industrial use.

Pipe. Eureka Pipe Co., 591 Washington St., Lynn, Mass.—4-page leaflet describing construction, advantages and uses of this company's cement-lined pipe for corrosion resistant applications.

Plating. Hanson-Van Winkle-Munning Co., Matawan, N. J.—Bulletins ER-101 and HC-104—Respectively 4 and 20 pages covering electroplating rectifiers; and buffs and compositions for use in finishing electroplated ware.

Plating. The Udylite Co., 1651 East Grand Blvd., Detroit, Mich.—4-page leaflet describing the Udylite semi-automatic plating machine; also leaflet covering protective clothing for platers.

Power Transmission. D. O. James Mfg. Co., 1114 West Monroe St., Chicago, Ill.—4-page leaflet with engineering data describing construction and advantages of this company's flexible couplings.

Pumps. American Steam Pump Co., Battle Creek, Mich.—Bulletins 450 and 455, Edition 1—Describe this company's Type Z turbine pumps in several models, and the corresponding types equipped with self-priming devices; both list specifications.

Pumps. Dayton-Dowd Co., Quincy, Ill.—Bulletin 810—6 pages on single suction centrifugal pumps for process industries use.

Pumps. DeLaval Steam Turbine Co., Trenton, N. J.—4-page folder describing service of one of this company's geared turbine pumping units, during the Louisville flood.

Pumps. Fairbanks, Morse & Co., 900 South Wabash Ave., Chicago, Ill.—Publications as follows: Bulletin 5814F, 6 pages on ball-bearing centrifugal pumps meeting fire pump requirements; Bulletin 5870, double-suction centrifugal pumps; Bulletin 6150, simplex self-oiling power pumps.

Pumps. Goulds Pumps, Inc., Seneca Falls, N. Y.—Form 3398-J—80 pages with descriptions and engineering data covering this company's industrial pumps in centrifugal, rotary and reciprocating types.

Pumps. Ingersoll-Rand Co., 11 Broadway, New York City—New catalog on

Cameron motor pumps, covering capacities from 5 to 1,000 g.p.m. and sizes from ¼ to 40 hp.

Pumps. Morris Machine Works, Baldwinsville, N. Y.—Bulletin 164—4 pages describing double-suction, horizontally split, centrifugal pumps.

Pumps. Nash Engineering Co., South Norwalk, Conn.—Bulletin 267—8 pages describing construction and uses of this company's unit type vacuum heating pumps.

Pumps. Quimby Pump Co., 340 Thomas St., Newark, N. J.—Bulletin R-330—8 pages with description and engineering data on oval- and gear-rotor rotary pumps made by this company.

Pumps. Roots-Connersville Blower Corp., Connersville, Ind.—Bulletins 61B10 and 55B10—Cover respectively new type three-lobe cycloidal pumps for viscous materials; and certain cycloidal units used as exhausters for priming large centrifugal pumps.

Refractories. Norton Co., Worcester, Mass.—"Handling Heat No. 5"—Briefly describes the use of Alundum and Crysotolite refractories as kiln linings and kiln furniture.

Roofs. Johns-Manville, 22 East 40th St., New York City—30-page book describing this company's built-up roofs with complete detailed specifications. Also 12-page bulletin on corrugated Transite for use in industrial roofing and siding.

Safety. Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh, Pa.—Bulletin EA-3—4 pages describing outstanding features of this company's all-service gas mask.

Safety. Mine Safety Appliances Co., Meade, Thomas & Braddock Aves., Pittsburgh, Pa.—Bulletin DT-1—4 pages on this company's combustible gas alarm.

Screen Cloth. International Nickel Co., 67 Wall St., New York City—Bulletin H-3—14 pages describing Monel metal industrial screen and filter cloths.

Screens. J. H. Day Co., Cincinnati, Ohio—Bulletin 365—8 pages on construction and uses of this company's gyrating screens.

Shims. Laminated Shim Co., 21-24 44th Ave., Long Island City, N. Y.—16-page catalog describing laminated shims made by this company and showing their use in the adjustment of bearings in all sorts of equipment.

Traps. W. H. Nicholson & Co., Wilkes-Barre, Pa.—Bulletin 337—6 pages illustrating and describing with engineering data this company's industrial steam traps.

Unions. Rockwood Sprinkler Co., 38 Harlow St., Worcester, Mass.—8-page folder describing in considerable detail properties and uses of this company's new Dualsteel pipe unions.

Valve Control. Philadelphia Gear Works, G St. below Erie Ave., Philadelphia, Pa.—48-page catalog with detailed description of this company's Limitorque control for valves, giving construction and operating details and showing application to valves of various sorts. Also discusses accessories.

Vents. Gorton Heating Corp., Grandford, N. J.—Bulletin 104—4 pages describing this company's high pressure air eliminator for automatically venting dryers and other equipment at operating pressures to 150 lb.

Welding. American Manganese Steel Co., 380 East 14th St., Chicago Heights, Ill.—Bulletin 20—Covers this company's hard facing welding rod, describing and illustrating applications.

PACIFIC COAST PAPER MEN HOLD MEETING IN VANCOUVER

Members of the Pacific Coast Division, American Pulp and Paper Mills Superintendents' Association Inc. and the Pacific Section, Technical Association Pulp and Paper Industry, met recently in Vancouver, B. C.

At the opening business session three addresses were given, Dr. J. D. Rue of the Hooker Electrochemical Co. speaking on "Recent Trends in Pulp Bleaching"; Andreas Christensen of the B. C. Pulp & Paper Company Limited addressing the meeting on the subject "The Trend in Sulphite Pulping" and W. S. Kirkpatrick of the chemical and fertilizer department of the Consolidated Mining and Smelting Corp. outlining the developments at his plant in the utilization of byproducts.

The final session was devoted to a roundtable discussion under the joint chairmanship of Carl Fahlstrom of the

Longview Fiber Co., Longview, Wash., and L. S. McCurdy.

Earl G. Thompson, of the Great Western Electrochemical Co., Seattle, retires as secretary-treasurer of TAPPI, while Andreas Christensen, who has served on the executive committee for a number of years, also drops from the committee. George H. McGregor of the Weyerhaeuser Co. was elected president, succeeding Carl Fahlstrom of the Longview Fiber Co., Longview, Wash.; N. W. Coster was appointed vice-president, with G. V. B. Cox, plant superintendent of the Paper Makers' Chemical Division of the Hercules Powder Co., Portland, Oregon, appointed secretary-treasurer. The executive committee will also include W. R. Barber, technical superintendent of the Crown Willamette Paper Co., Camas, Wash., with the retiring chairman.

Three Floors Will House Chemical Show

The Sixteenth Exposition of Chemical Industries will present a brilliant pageant of American industrial recovery in terms of the contributions of chemistry and chemical engineering. The Exposition will be held at Grand Central Palace, New York, Dec. 6 to 11. Three floors of Grand Central Palace have been reserved and the advance leasing of exhibit space indicates that the 1937 Exposition will be one of the most representative and comprehensive in recent years. Dr. M. C. Whitaker, vice-president of the American Cyanamid Co. and a distinguished figure in the chemical industry will be chairman of the Advisory Committee.

The Sixteenth Exposition of Chemical Industries will present its moving, colorful pageant this December in terms of raw materials, the machines and processes which convert these into finished products, and finally the products themselves. Principal sections at the Exposition will include the following: chemicals and chemical products, metals

and alloys, laboratory equipment and supplies, instruments of precision, containers and packaging, materials handling equipment, brewing, distilling and bottling equipment, industrial chemical equipment and machinery. A number of exhibits will feature the modern synthetic plastics and molded products, also lacquers, varnishes and corrosion resisting surface coatings of wide variety. Exhibits designed to explain natural resources and industrial opportunities for plant location, and a variety of educational exhibits will complete the pageant of exhibits.

Fall Meeting of T.A.P.P.I. At Savannah

The fall meeting of the Technical Association will be held at the De Soto Hotel, Savannah, Ga. on October 18-20, 1937. Reservations should be made direct with the hotel. The meeting program will feature the Southern pine pulping developments. The first day will be devoted to details concerning the economics of Southern pulpwood and a

visit to the local woodlands will be arranged.

The second and third day will deal with pulping and bleaching developments as well as to a consideration of some new fundamental concepts regarding the cellulose fiber structure. Details regarding the program will appear from week to week in the trade journals.

Visits to the Union Bag and Paper Company mill, the Laboratory of the Industrial Committee of Savannah, the Hercules Powder Naval Stores plants, etc. are all part of the program, and the social program will include golf, banquets, clam bakes and organized entertainment which will probably be the best ever seen at a TAPPI fall convention. The people of Savannah are preparing a program of unusually fine entertainment for the men and ladies who attend.

First Viscose Rayon Plant Opens in the Argentine

The first viscose rayon plant in Argentina, located approximately fifteen miles from the City of Buenos Aires, was formally inaugurated last month in the presence of invited guests, who included General Augustin P. Justo, President of Argentina, and other national and state authorities and representatives of banking, commercial and industrial interests. The plant was constructed and will be operated by a company known as "Ducilo" S. A. Productora de Rayon, an affiliate of Industrias Quimicas Argentinas "Duperial," of Buenos Aires. Frank S. MacGregor is president of Ducilo, which has an issued capital of 34,000,000 Argentine pesos.

The process of manufacture employed in the new factory was supplied by the Rayon Department of the du Pont company and the Argentine company is also entitled to avail itself of such technical and process improvements which the Rayon Department of the du Pont company may develop.

Bromine Production Larger Last Year

The Bureau of Mines reports that the domestic production of bromine jumped in 1936 to 20,609,025 lb. valued at \$4,038,438, an increase of 25 per cent in quantity and 16 per cent in value more than 1936, the previous record year. Bromine was produced in this country as early as 1846 but there was no real demand for it until 1860 when it began to be recovered in a small way in Germany and as recently as 1928 domestic consumption scarcely equalled 10 per cent of the quantity used last year. Production rose to 6,414,620 lb. in 1929 and except for a sharp setback in 1932, continued to rise steadily throughout the depression.

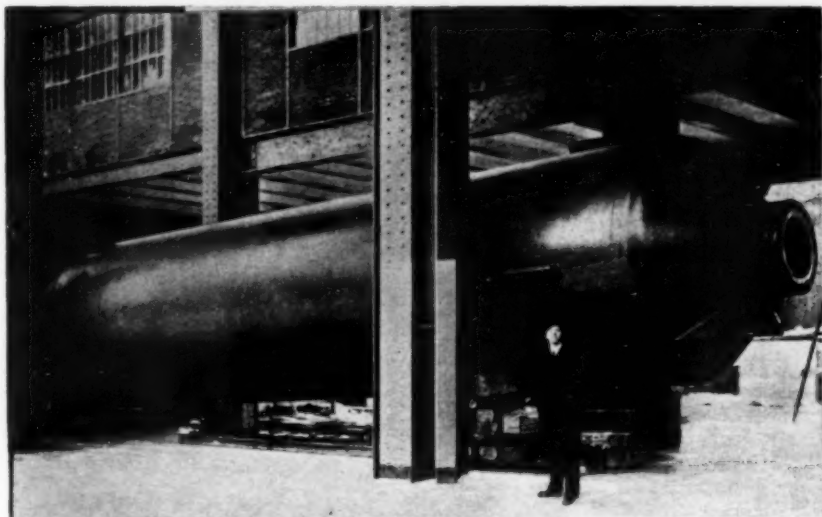
LARGE-SCALE EQUIPMENT EXHIBITS FEATUREACHEMA EXPOSITION

By Special Cable From Frankfort-on-Main

Achema VIII was officially opened July 2 in Frankfort-on-Main, before a distinguished group of chemical engineering, political and military leaders not only of Germany but of the entire world. Its exhibits covering a space of 12,000 sq.m. in seven halls, attracted during the first three days an attendance of more than 30,000 people. The total number of exhibitors this year is 360,

to a display of contemporary German chemical literature. All of this was laid out library-style on tables for ease in examination and reference.

Included among well-known American chemical engineers in attendance at Achema are the following: Dr. Gaston DuBois, vice president in charge of research, Monsanto Chemical Co.; Dr. Gustavus J. Esselen, consulting chemi-



One of the larger pieces of equipment exhibited at Achema VIII: A pressure vessel for the wood distillation industry, 9 ft. in diameter, 50 ft. long and weighing approximately 60 tons. It was fabricated by the firm of Rheinmetall-Borsig, A.G. of Berlin

for whom more than 20 miles of electric cable were installed to supply power and light for the operation of their exhibits.

An outstanding feature was the large-scale equipment shown in actual operation in the production of synthetic plastics and textile fibers. Molding presses are busy turning out souvenir plaques and samples of a wide variety of plastics. A complete operating plant for the production of synthetic wool from viscose, demonstrated the different steps in spinning, washing and winding this material which was then woven into cloth on a hand loom in the building.

Other exhibits included a vast collection of plant equipment of glass, quartz, earthenware, and resins, as well as a complete display of newer metals and alloys of aluminum, copper, chromium, nickel, etc. Some of the pressure vessels exhibited weighed as much as 60 tons.

The new feature of this year's exposition was an entire building devoted

Editor's Note: A complete report of outstanding exhibits of principal interest to American chemical engineers will be published in *Chem. & Met.* next month.

cal engineer of Boston; Dr. L. F. Nickell, chairman, Monsanto Chemicals, Ltd., London; Dr. Jules Bebie, consulting chemical engineer, St. Louis; Dr. Gustave Egloff, Universal Oil Products, Chicago; Guy N. Harcourt, New York manager, Buffalo Foundry & Machine Co.; L. T. Sharples, Sharples Specialty Co., Philadelphia; L. M. Tolman, director of research, Wilson & Co., Chicago; J. M. Moul, president and general manager, the Turbo-Mixer Corp., New York; Dr. Harrison E. Howe, American Chemical Society, Washington; Dr. Thomas H. Chilton, Experiment Station, E. I. du Pont de Nemours & Co., Wilmington.

Fertilizer Materials by Blast Furnace Method

Low-grade phosphate rock may be smelted and used as advantageously in some cases as the more expensive high-grade materials, according to results obtained in an experimental blast-furnace plant described in a new bulletin by the Fertilizer Research Division

of the U. S. Department of Agriculture.

The results indicate that savings may be expected by the simultaneous production of phosphorus and potash in a single furnace over their production in separate furnaces. This would enable the producer to ship potassium phosphate, a material containing from 85 to 100 per cent plant food which can be applied directly to the soil.

Establishment of the fundamental principles of phosphate smelting is expected to increase the effective phosphate reserves of the country by encouraging the development of deposits of Idaho, Montana, Utah, and Wyoming. The main product of the new furnace is elementary phosphorus, which is required in time of war, and which may be transported economically long distances for conversion into phosphoric acid and agricultural phosphates. The blast furnace smelting of Rocky Mountain potassium silicates was shown to be technically possible under the new method, but not profitable under the present conditions, and prices of potash.

During the investigations a new type of hot-blast stove was developed which is not only less expensive to construct and more efficient to operate than the usual types, but capable of producing blast temperatures 500 or more degrees Fahrenheit, higher than is customary in iron blast-furnace practice. The use of these high blast temperatures reduces the fuel requirement in phosphate smelting from 25 to 30 per cent, and thereby substantially reduces the cost of producing the phosphatic materials.

Chemical Transportation Makes Safety Record

Despite an enormous increase in the transportation of chemicals, no serious accident has taken place involving chemicals in transit in more than ten years, it is shown in the report of W. S. Topping, chief inspector of the Bureau of the Safe Transportation of Explosives and Other Dangerous Articles, operating under the direction of the Association of American Railroads.

Formed originally in 1906 to minimize accidents resulting from the shipment of explosives, the Bureau was expanded to include a diversity of products designated as "other dangerous articles." Last year witnessed a record total in chemical tonnage shipped, without fatalities or material property damage.

"With the general improvement in business, there has been an increase in the tonnage of dangerous commodities of all kinds," Mr. Topping points out, "but the principal shippers of dangerous articles are always cooperating with the Bureau in the application and enforcement of rules for safety. They are as much interested as the railroads in preventing explosions, fires or personal injuries."

"PESSIMISTIC PROSPERITY" is Washington's present appraisal of the business situation. The prosperity relates to the quantity of business more than to the profits. The pessimism comes from the all too obvious problems created by the joint efforts of the New Deal and C.I.O.

Apparently the President has discovered a new technique for economic planning. By this he occasions just enough of the jitters among business men in order to accomplish his current purpose. When he thinks that big industry is getting too cocky, he comes out with a new blast or a new threat of legislation, taxation, or reform. One can reasonably suspect that this is a deliberate technique used for the purpose of controlling prices of goods, the price of money, and those other business factors which rest essentially on psychology. Naturally no official admission can be expected. But the technique is being used, whether consciously or not.

Legislation

Referring to the stream-pollution bill in the Senate committee on commerce, one important trade association news bulletin to its members says picturesquely: "Situation controversial." The same label might well be attached to almost every legislative proposal for, as the Chamber of Commerce of U. S. says, "Growing dissension between the Administration and Congress over a legislative program obscures the immediate Washington outlook." And the future outlook is even more uncertain. No one, not even the President, is now ready to guess trends or speed in legislative matters.

The revolt in Congress has as its main objective the control of the Democratic party for 1940. The rebels now include practically all of the more experienced leaders. These men are too skilled in politics to believe that they can gain domination for 1938, much as they would like to do so but the groundwork may be laid for 1940.

Many trades will be made, seeming like the surrender of insurrectionists. They will not be that. They will be, rather, the necessary tactical retreats before a superior force in order that the rebels may choose their own battle ground for decisive engagements. It is mere speculation to forecast where these battles will be fought, who will win, and how decisively. It does seem certain, however, that distinct realignment of parties will have been accomplished by 1940. Thus the major question is not who will control the Democratic party; the major question is, will New Deal and labor elements sufficiently weld to form a dominant unit at that time. Thoughtful business critics are expressing the hope that there will be three major parties that year, New Deal, Labor, and Conservative. Then, they

NEWS FROM WASHINGTON



Washington News Bureau
McGraw-Hill Publishing Co.
Paul Wooton, Chief

say, there is some chance for a liberal Conservative victory.

There seems no reason to believe that the labor situation can improve until after it has become much worse. Congressional leaders do not like the present "irresponsible" leadership of C.I.O., nor the official acquiescence in this at the Department of Labor and the White House. But Congress will not force the hand of the Chief Executive until a substantially larger percentage of the American people demand this.

It is not reasonable to expect official intervention and correction until more violence and greater evidence of irresponsibility persuades farmers, white-collar workers, and unorganized wage workers that their interest is being harmed. The fact that so-called "thinking people" are already unanimous in criticism makes little difference. They constitute too small a percentage of the population, particularly too small a percentage of the voters.

The Labor Situation

Present labor difficulties are expected to spread into any area of the industry which C.I.O. undertakes to organize. And there is no reason to believe that the appetite of that amazingly aggressive agency will be satisfied soon. Nor is it to be expected that the wiser leaders will be able to control new groups in the enthusiasm of their current achievements.

Chemical industry will have its turn and here and there may be serious results. Washington expects this. But there is one element of comfort noted. Secretary of Labor Perkins has on several occasions indicated her feeling that the chemical industries are safe only because of the rigid discipline in management. She apparently thinks that the type of unionization which progresses with her encouragement elsewhere would be too hazardous to workers and the public if allowed in chemical enterprises. If there be no untoward evidence of re-

actionary management in chemical firms there may, therefore, be peaceful progress along labor lines.

A secondary effect on chemicals is expected from the present labor situation. In a number of cases consumption of chemicals is interfered with. In other instances modified sources of supply are necessary. An important example of the latter is found in the case of ammonium sulphate for the fertilizer industry. Interruption of steel-plant operation is somewhat reducing the byproduct supply and giving encouragement to synthetic producers and foreign importers. This type of indirect disturbance is more likely to be met in the case of chemicals than are the direct effects, in which new labor agreements will cause sharp change in costs and prices.

It's dishonest to evade a tax. It's "immoral" even to avoid one. This is the philosophy of the President and Secretary Morgenthau before Congressional committees. The critics, and some Congressmen, ask "If there has been evasion, why has it not been investigated and the unscrupulous prosecuted?" The Treasury has difficulty in answering. Thus the tax charges sent to Congress by the President the first of June have returned to plague the Administration.

Some plugging of loopholes is expected. But Congress knew of these loopholes two and three years ago when it passed previous laws. It is not expected that very much change in basic regulation will be made. Much more important to business will be the new tax law on which hearings will start in November, according to present plans. Then the results of the present fundamental study by the Treasury Department will be reported to the Congressional committees and the drafting of a new bill will start.

As expected, Congress extended all of the nuisance taxes and special excise levies on oil, copper, lumber, etc. The Treasury needed the money so badly that no money-raising law could be allowed to lapse. And even those items in the bill which did not raise any real money, the copper tariff for example, could not be eliminated without danger of having the whole fabric ravel out and make intolerable Treasury losses.

Sodium Chlorate—A Correction

An unfortunate misunderstanding led to the signing of the U. S. Bureau of Chemistry and Soils article on the electrochemical production of sodium chlorate "by P. H. Groggins and Associates." (See *Chem. & Met.* pp. 302-7.) Credit for this outstanding research as well as the authorship of the article were shared with A. L. Pitman, James McLaren and F. H. Davis of the electrochemical group of the Industrial Farm Products Research Division—to all of whom *Chem. & Met.* extends its apology.—EDITOR.

GERMANY COORDINATES RESEARCH WORK TO DEVELOP HOME MATERIALS

From Our German Correspondent

GERMANY'S intensive drive to utilize every available domestic raw material is leading to exhaustive research, all of which has been affected in one way or another by raw material shortages. To avoid duplication of research and to facilitate the exchange of experience, more than 1,000 individual research bureaus connected with factories and scientific institutions have been coordinated under the recently organized Reichsforschungsrat (National Research Council) which is subdivided into 15 special groups. The group Chemistry and Physical Chemistry is headed by General Becker; Motor Fuels by Prof. A. W. Schmidt, president of the University of Munich and director of the Institute for Chemical Technology; Organic Materials (synthetic resins, rubber, textiles, fats, cellulose) by Prof. Peter Thiesen, director of the Kaiser Wilhelm Institute for Physical and Electrochemistry, Berlin; Non-Ferrous Metals by Prof. Köster, director of the Kaiser Wilhelm Institute for Applied Metallurgy, Stuttgart.

To coordinate individual effort, engineers and chemists, members of the five leading organizations: Verein Deutscher Ingenieure (V.D.I., engineering), V.D. Electrotechniker (electro-technique, etc.), V.D. Chemiker (chemistry), V.D. Eisenhüttenleute (mining and metallurgy), Deutsche Gesellschaft für Bauwesen (building), have recently been joined under a top organization Bund Deutscher Technik, which is a semi-political organization headed by Dr. Fritz Todt, chief of roads and head of the national Bureau of Technique.

The founding of companies in various states to investigate and develop natural resources has already been reported. The most recent organization is the Gesellschaft zur Untersuchung deutscher Eisenerzlagertstätten G.m.b.H. to investigate hitherto undeveloped German iron and manganese deposits, which has been formed in Essen with a capitalization of one million RM by the Stahlverein, Krupp, Hoesch, GHH, Klöckner, Mannesmann, and Ruhrstahl.

In various places successful experiments have been carried out with the reclamation of municipal garbage. Hogs are fed with edible portions of garbage, which like waste paper is placed in separate containers for collection. After rubber and tin cans and metal have been reclaimed, the remaining garbage is treated in various ways and is used as fuel for firing power plants, in pressed form as building material insulation, as

highway covering, etc., and in agriculture as fertilizer. The last-named use supplements the regular sewage farming carried on by several cities in Germany for years.

Germany now supplies an increasing share of her resin requirements through domestic production at Eberswalde, where a bureau for resin research and production has been established. Formerly her supply was furnished 75 per cent by the United States, partly by France, Spain and Portugal. In Germany experimentation and resin production from pine and fir trees, which had been carried on during the War but was abandoned because of the costly and unsatisfactory product, was taken up again in 1932. This time only low-quality fir trees are being used, and the resin, which is claimed to be as good as the foreign product, is being sold to commercial firms for distillation. It is said to average 22.1 per cent turpentine oil, 72.6 per cent colophonium, and 5.3 per cent waste. Production, it is admitted, would not be economical without the help of the Reich Labor Service in the 5,000 hectare forests. Experimentally, resin is also being extracted from otherwise worthless diseased pine trees, and this production as well as the extraction from cut timber later to be chemically treated for making paper and sugar, is to be extended considerably this year.

Besides utilizing wood for making cellulose, according to Scholler and Bergius processes, factories in Mannheim, Dessau and in the Weser district are making alcohol, yeast and sugar from wood. The sugar product, not as sweet as cane and beet sugar, but which can be made at greater expense into table sugar, is now being mixed with potatoes and used as a high grade carbohydrate fodder.

Red beech wood is being processed in increasing quantities in Germany into "lignostone," a tough compressed material suitable for making weaving shuttles and slide bearings, which are claimed to be much harder than if made from pockwood. The wood is divested of humidity, then saturated with oil and resin and subjected to a tremendous pressure, whereby the specific gravity of the material is increased to 1.4.

In synthetic resin industries Germany now employs about 50,000 workers, the main synthetic plants being located near the processing metal industries, as Lüdenscheid, Berlin, and in central and southern Germany. In 1934 the industry produced 15,000 tons of beginning

materials, mostly from phenol and cresol bases, valued at 23 million RM, and in 1935 production reached 50 million RM. The value of the finished products made from the beginning materials was estimated at about 150 million RM in 1934 and at 300 million RM in 1935 and has since increased.

The Berlin exhibition of technical progress during the past four years and the Duesseldorf national exposition show parts of actual manufacturing operations and have extensive displays illustrating the wide variety of uses for synthetic resins in the electrotechnical, office machinery, optical, photographic, radio, and household articles industries.

Dynamite-Nobel (I. G. Farben) at Troisdorf near Cologne, probably the largest manufacturer of synthetics in Europe, in its latest annual statement reported considerable gains in the production of phenol and cresol plastics. During the past months new types of greater durability and adaptability for use in machinery, especially as gears and bearings, claimed to stand 10 to 20 times the wear of certain metal bearings, have been developed and placed on the market. Vinyl products were also used increasingly in batteries, packing, cable casings, and drawn seamless pipes, and since the material can be easily pressed into folios and plates, it has filled an important gap in products between celluloid and cellone.

Modified phenol resins are also being used successfully in the German paint and varnish industry to replace foreign raw materials. The State railways are applying phenol resin lacquers in painting the interior of passenger cars and alkyd resin lacquers for the exteriors of dining and sleeping cars. The synthetic lacquers are claimed to dry in 1 to 3 hours, forming an elastic but hard coating, which can also be applied directly to metals without a preliminary ground coating. The German army is also using alkyd resin lacquers, resin-oil lacquers, chlorcautouch lacquers and combination lacquers with cellulose derivatives in painting much of its equipment, and reports that the average oil content of paint used for this purpose has been reduced from 22 per cent to between 7 and 10 per cent. For wood impregnation the former imported linseed oil varnishes have been almost completely replaced by nitrocellulose products. On the basis of recent experiments the State railways have gone over to using red lead with 40 per cent heavy spar in order to save lead. Since last October a new white lead "Bleiweiss Z" has been on the market; it contains 30 per cent white lead and 70 per cent zinc oxide and is claimed to be just as weather-resistant as the older paints. To save linseed oil an "El-Firnis" (uniform varnish) was introduced last year; it is claimed to effect a 67 per cent saving in oil, but painters have been reluctant to use it.

LABOR TROUBLES AND SOCIAL LAWS AFFECT FRENCH INDUSTRY

Special Correspondence

AT present the labor question is the most pressing for French industry. The introduction of new social laws, reduced working hours, and the development of unions threatens to upset the established economic order. As far as the domestic market is concerned, French industry was able to pass on all additional cost of production to the ultimate consumer. However, this general rise of prices is upsetting all calculations; the strict enforcement of the 40-hour week, in conjunction with the many strikes makes delivery terms entirely illusory. The rise of world market prices is increasing the difficulties for French industry, while labor considers itself cheated out of the promised benefits.

The chemical industry finds itself in a somewhat better position than other branches. Of comparatively recent origin, it possesses better equipment and a more modern organization than old established French industries, besides being much less sensitive to the wage problem and labor in general.

The depletion of stocks caused a considerable upturn in production in the second half of 1936, notably since the devaluation of the Franc, when orders were placed to avoid price increases that had to be expected. Pigments, insecticides, leather and textile industry products profited most; manufacturers of equipment and efficiency experts have to meet increasing demands for their products and services.

Complete utilization of coke-oven gas has made great progress, especially the production of "ethylene" and its derivatives such as glycols, "ethylene dioxide," as well as of ester solvents.

The problems of substitute and synthetic motor fuels is in the foreground of public and scientific attention. Important refineries have been built during the last few years able to satisfy all demands of peace time. Every domestic source of supply of substitutes has been investigated and tested, and efforts are being made to try out French coal deposits in view of obtaining the coveted gas even in time of war independent of crude oil imports.

One commercial plant using the Fischer hydrogenation process is nearing completion. One pilot plant is working on the Audibert process which is quite similar to the IHP system except for a mechanical mixer; however, this device does not seem to work quite satisfactorily, and one does not meet with much enthusiasm for this process.

Another pilot plant is operating on the Vallette process, an entirely French

development. Vallette wanted to eliminate the big converters that cannot be furnished by domestic steel works, as well as utilize a cycle that keeps intact the unavoidable "supporting" oil; otherwise, he argues, there could be no real independence from foreign supplies. Unfortunately, very little is being communicated in regard to these developments. The converter is being replaced by numerous short tubes of small diameter; they are placed like a "water wall" in a certain section of a coke-oven, and force the mass to a circuitous passage.

Both French methods differ from the IHP in regard to the fractionation of the hydrogenated products. Audibert uses the Ab-der-Halden process. Vallette obtains directly three different fractions. By cooling under pressure towards 300°C., all products with higher boiling points, including the "supporting" oil, are condensed; further cooling, still under pressure, releases medium and light oils. Finally, at atmospheric pressure, activated carbon retains "gasoline" while the rest gas is used either for heating, or re-circulated under admixture of fresh hydrogen.

James H. McGraw, Jr. Heads McGraw-Hill Company

Effective June 21, James H. McGraw, Jr. was elected president of the McGraw-Hill Publishing Co. to succeed Malcolm Muir, resigned. Mr. McGraw, Jr. continues as chairman of the board and assumes the additional responsibilities of the office of president.

Following his graduation from Princeton University in 1915, Mr. McGraw entered the service of the company and for twenty-one years has served actively in various posts connected with its publishing activities. After eight years of service with individual papers and groups of papers, he entered the general management of the company as treasurer in 1923, and became executive vice president in 1932. In 1935 he was elected chairman of the board to succeed James H. McGraw, founder of the company.

In 1932 and 1933, Mr. McGraw served as president of the Associated Business Papers and in addition to his work in his own company he has contributed generously of his time and effort to the advancement of business paper publishing. Thoroughly grounded

CALENDAR

AMERICAN CHEMICAL SOCIETY, semi-annual meeting, Rochester, N. Y., September 6-10.

AMERICAN GAS ASSOCIATION, annual convention, Cleveland, Ohio, September 27-October 1.

CHICAGO EXPOSITION OF POWER AND MECHANICAL ENGINEERING, International Amphitheater, Chicago, Ill., October 4-9.

ELECTROCHEMICAL SOCIETY, fall meeting, St. Louis, Mo., October 13-16.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, fall meeting, Savannah, Ga., October 18-20.

AMERICAN PETROLEUM INSTITUTE, annual meeting, Chicago, Ill., November 8-12.

16TH CHEMICAL EXPOSITION, Grand Central Palace, New York City, December 6-11.

AMERICAN CHEMICAL SOCIETY, semi-annual meeting, Dallas, Texas, April 18-21, 1938.



James H. McGraw, Jr.

in the editorial tradition, he has applied himself aggressively to keeping the business paper abreast of what is best in modern publishing practice from the viewpoint of both readers and advertisers.

PERSONALITIES

♦ A. E. BENDELARI has resigned as president of the Eagle-Picher Lead Co. and associated companies. He will, however, retain his directorship in the American Mining Congress, the American Zinc Institute and the Lead Industries Association as a special representative of Eagle-Picher. He will be succeeded in the presidency of the company by Joseph T. Hummel, Jr., former secretary-treasurer.

♦ PERCY H. WALKER, chief chemist of the Bureau of Standards, is retiring from this post at the end of July. Mr. Walker will continue in technical work, particularly in a consulting service with John T. Lewis Co. of Philadelphia. His personal address will continue to be at Washington, D. C.

♦ E. W. K. SCHWARZ has joined the staff of the Arkansas Co., Inc. as technical director. He is well known as technical editor of *Rayon Textile Monthly* and was formerly connected with the General Dyestuff Corp.

♦ CHARLES L. MANTELL has resigned as head of the chemical engineering department of Pratt Institute to engage in private consulting work in Brooklyn, N. Y. He will devote much of his time to directing research for the American Gum Importers Association.

♦ BRADLEY DEWEY, president of Dewey and Almy Chemical Co., Cambridge, Mass., has been elected a life member of the governing board of Massachusetts Institute of Technology.

♦ JAMES H. BOYD, JR., formerly assistant manager of the research and development department of the Atlantic Refining Co., has accepted a position at the Wilmington experimental station of E. I. du Pont de Nemours & Co.

♦ JOHN C. HOSTETTER, vice-president in charge of research and development, Hartford-Empire Co., Hartford, Conn., has been awarded Franklin Institute's Howard N. Potts medal for his work in extending the uses for glass.

♦ WILLIAM G. HARVEY, manager of magnesium products at the Cleveland works of the Aluminum Co. of America,

was elected president of the Electrochemical Society at its annual meeting in Philadelphia.

♦ JOHN S. HAUG, consulting engineer of United Engineers & Constructors, Philadelphia, has received the Edward Longstreth Medal of the Franklin Institute "in consideration of the invention and development of an improved type of mechanical clinkered water gas generator."

♦ J. F. BLACKIE has announced his resignation from the executive vice-presidency of the National Enameling and Stamping Co. of Milwaukee. He will turn his attention to travel and personal interests.

♦ R. M. PALMER, consulting chemical engineer of New York City, has been elected president of the graduate school alumni of Columbia University, succeeding Dr. Marston Taylor Bogert, of the University's department of chemistry.

♦ ALBERT E. WHITE, director of the department of engineering research at the University of Michigan, was elected president of the American Society for Testing Materials at its annual meeting in New York City last month.

♦ W. H. SWANGER and G. F. WOHLGEMUTH, respectively chief of the section of mechanical metallurgy and associate metallurgist of the National Bureau of Standards, have been awarded the A.S.T.M. Charles B. Dudley Medal for 1937. The award is made each year to the authors of the papers of most outstanding merit presented at the preceding annual meeting.

♦ ROGERS W. RICHARDSON, formerly of the technical staff of the Standard Oil Co. of Louisiana at Baton Rouge, will head work on motor oils at the Esso Laboratories of the Standard Oil Development Co. at Elizabeth, N. J.

♦ WILLIAM B. WIEGAND, director of carbon research for the Columbian Carbon Co., delivered a paper on properties of colloidal carbon before the Congress International de Caoutchouc, world organization of rubber technologists meeting in Paris last month.



H. F. Willkie

♦ H. F. WILLKIE has joined Distillers Corporation—Seagram's Ltd., and will be elected vice-president and director, according to Samuel Bronfman, president. He will be in charge of plants and production of all the subsidiary companies. Formerly director, vice-president and member of the executive committee of Hiram Walker—Gooderham & Worts, Ltd., Mr. Willkie has devoted his entire professional career to research and production in distilling.

♦ GEORGE B. HUGHEY, of the chemical engineering staff of Ohio State University, will be associated during the summer months with the Southern Kraft Corp., Panama City, Fla.

♦ E. S. PETTYJOHN, formerly in the process division of Leader Industries, Inc., has accepted a position as assistant professor of chemical engineering at the University of Michigan.

♦ W. H. KING, formerly of the De Laval Separator Co., is now chemical engineer in the research and development division of Socony-Vacuum Co.

♦ R. A. BARACKMAN, of the Victor Chemical works, has been installed as chairman of the midwestern section of the American Association of Cereal Chemists.

MANUFACTURING OPERATIONS LOWERED IN CURRENT MONTH

JUNE closed a half-year during which general industrial production was on a higher plane than for any corresponding six-month period since 1929. Chemical production—taking the industry as a whole—cannot be definitely measured owing to lack of manufacturing data but it is probable that an all-time record of output was established.

In recent weeks seasonal influences and labor troubles have been factors in slowing up productive activities in different lines and these conditions have had some reflection on the chemical industry but a relatively high rate has been maintained and in certain cases deliveries were speeded up in June as some consumers were eager to accumulate raw material supplies in anticipation of higher prices which were to go into effect on deliveries over the third-quarter of the year.

According to *Engineering News Record*, June engineering construction awards reached a total of \$274,399,000, the highest dollar volume for any June since 1930, and the highest monthly total since January, 1936. This is a gain of 17 per cent over May, and 49 per cent over June, 1936.

Construction for the first half of 1937 was 15 per cent above 1936. Private awards were 124 per cent higher, while public awards were 25 per cent lower than the corresponding six months last year.

Total net sales and collections on accounts receivable showed substantial improvement during May 1937 for the group of manufacturers reporting in the monthly joint study of the National Association of Credit Men and the Bureau of Foreign and Domestic Commerce. This is a continuation of the gains in sales recorded by this group of manufacturers for each month since January 1936 when compared with the same month in the previous year.

The total net sales of the 560 manufacturers throughout the country reporting in May 1937 registered an increase of 20.7 per cent from May 1936. Without adjustment for seasonal influences,

May 1937 sales registered a decrease of 3.2 per cent from April of this year.

Increased sales in May over the corresponding period of last year were reported for most of the 15 industry groups included in the survey. Percentages of increase for some of the groups were: chemicals and allied products, 16.2; paints and varnishes, 5 per cent decrease; pharmaceuticals, 2.8 decline; petroleum products, 7.3; rubber products, 26.4; leather products, 32.7; stone, clay, and glass, 33.8; textiles, 10.6; paper, 45.5; and non-ferrous metals, 39.9.

Normal summer lull, accentuated by labor turmoil and apprehensions regarding legislation has caused a slowing up in industrial activity throughout the country, according to the monthly bulletin of the National Association of Purchasing Agents. Nevertheless, it adds, consensus is that present conditions are temporary and that an active fall season should follow.

Production costs are increasing and further price weakness is not anticipated, there being considerable probability that present levels will prove the bottom. Inventories are showing definite signs of being worked down. Collections have not yet shown any direct reflection of the easier business tone.

Consumption of crude rubber by manufacturers in the United States for May is estimated to be 51,733 long tons, compared with 51,797 long tons for April, according to the Rubber Manufacturers Association. Consumption for May, 1936 was 50,612 (revised) long tons.

May reclaimed rubber consumption is estimated at 14,693 long tons, production 15,793 long tons, stocks on hand May 31, 14,647 long tons.

Reversing the upward trend which had been so pronounced in recent months, aggregate fertilizer tax tag sales in 17 States were slightly smaller in May than in May, 1936. In view of the unusually large spring season and of the fact that May sales ordinarily account for only about 6 per cent of the year's total this slight decline is without significance.

Despite the lag in heavy commodities April exports of chemicals and related products continued at the six-year peak established during the preceding month and were 22 per cent above the record for April, 1936, according to the Department of Commerce.

Heavy commodities such as rosin, phosphate rock, sulphur, and certain other heavy commodities are not following the upward trend shown by practically all other items on the list due mainly to the difficulty and high cost of obtaining shipping facilities.

The total value of all chemicals and related products exported in April was recorded at \$15,445,000—a figure almost identical with that of the preceding month—and compares with \$12,700,000 for April, 1936, \$9,903,000 for April, 1935, and \$7,339,000 for April of the depression year 1933.

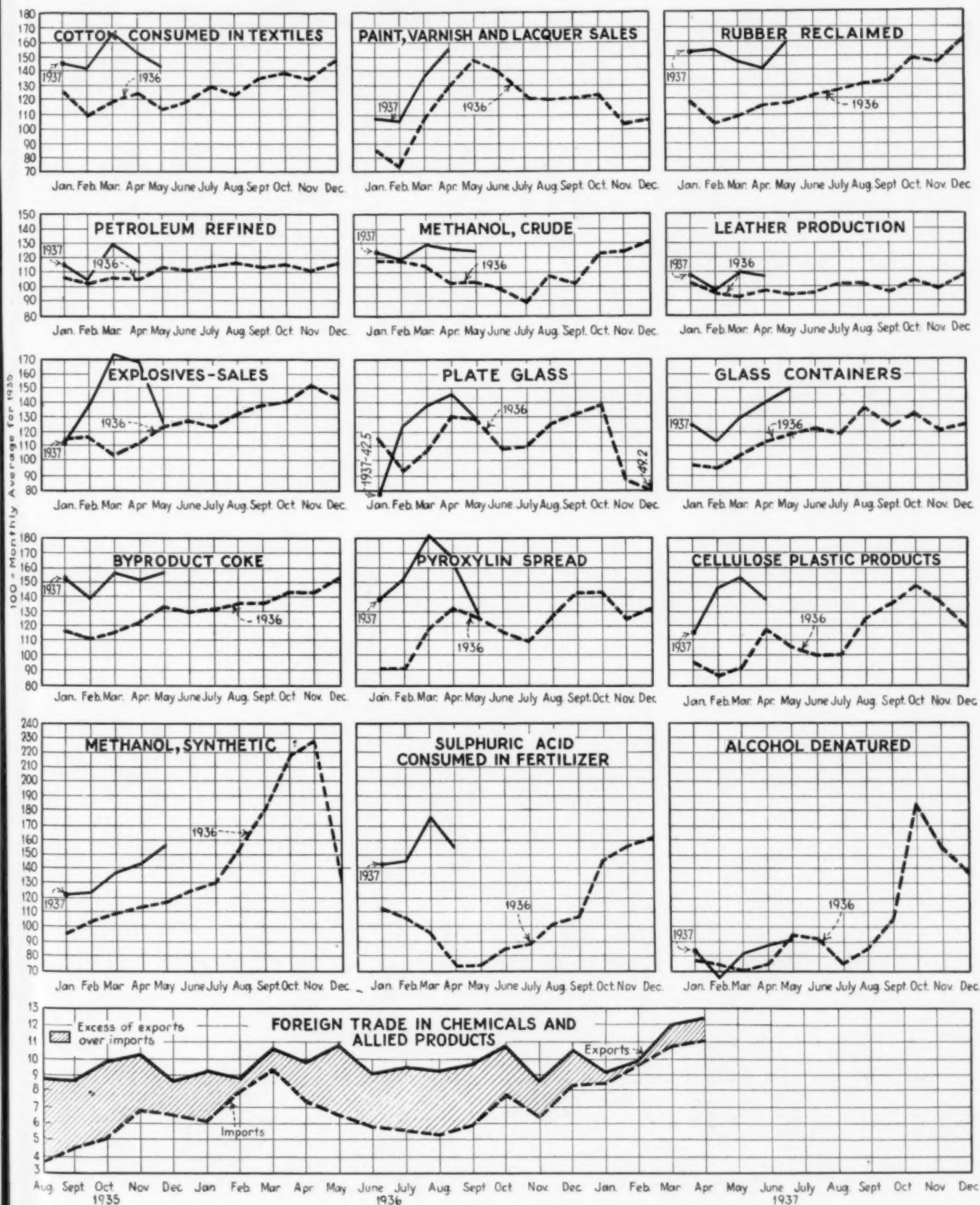
Export shipments of products classed as industrial chemicals were valued at \$2,464,700 in April compared with \$1,835,000 in the corresponding month of 1936. In this group exports of sodium compounds increased from 47,600,000 lb. to 62,300,000 lb., while heating, refrigerating, and other gases declined from 7,932,000 lb. to 1,203,000 lb.

Production and Consumption Data for Chemical-Consuming Industries

	May, 1937	May, 1936	Jan.-May, 1937	Jan.-May, 1936	Gain for 1937, per cent
PRODUCTION					
Alcohol, denatured, 1000 wi. gal.	7,442	7,635	33,376	31,521	5.9
Ammonia, tons*	71,823	59,229	346,794	268,209	29.3
Automobiles, number	516,899	460,512	2,291,551	2,035,592	12.6
Benzol, 1,000 gal.	10,435	9,289	51,391	40,742	26.1
Byproduct coke, 1,000 tons	4,474	3,753	21,666	16,927	28.0
Cellulose acetate plastics, 1,000 lbs.	1,411	1,221	5,155	3,473	48.4
Nitrocellulose plastics, 1,000 lbs.	1,692	1,388	7,177	5,164	39.0
Glass containers, 1,000 grs.	4,844	3,810	21,504	16,914	27.1
Plate glass, 1,000 sq. ft.	19,437	19,192	87,185	85,837	1.6
Methanol, crude, 1,000 gals.	523	427	2,627	2,318	13.3
Methanol, synthetic, 1,000 gals.	2,353	1,755	10,249	8,039	27.5
Pyroxylin spread, 1,000 lbs.	5,555	5,422	32,977	24,036	37.2
Rosin, wood, bbl.	62,399	53,640	303,776	264,024	15.1
Turpentine, wood, bbl.	9,637	8,636	48,010	43,660	10.0
Rubber reclaimed, tons	15,793	11,512	74,460	55,459	34.3
CONSUMPTION					
Cotton, 1,000 bales	669	531	3,509	2,765	26.9
Silk, bales	35,278	32,087	198,445	173,699	14.3
Explosives, sales, 1,000 lbs.	31,972	30,394	172,846	130,608	32.3
Rubber, crude, tons	51,733	50,612	256,620	230,598	11.3
Paint, varnish and lacquer, sales, \$1,000	43,355	40,950	185,735	151,056	23.0

* Sulphate equivalent of byproduct production.

TRENDS OF PRODUCTION AND CONSUMPTION



UPWARD PRICE MOVEMENT FEATURES TRADING IN CHEMICALS

REDUCTIONS in withdrawing some chemicals are anticipated for at least part of the current quarter. This is due partly to the abridgment of some production schedules under the influence of seasonal conditions and partly to the fact that call for deliveries of certain chemicals was increased in June because of higher sales prices which went into effect on July 1. Demand for raw material supplies emanating from the automotive, rubber, glass, and paint trades has shown a tendency to fall off from the rates established in preceding months and this condition is not expected to improve in the next month.

Total movement of chemicals, however, is reported as relatively good with prospects for an active movement in the latter part of the year. The prevalence of labor troubles has had an adverse effect on consumption of raw materials in general and the outlook is still clouded by uncertainty regarding the extent to which such difficulties will continue.

The price situation has been the most important feature to the market in recent weeks. Higher production costs had made it apparent that many of the finished products would sell at higher levels and many upward revisions have been announced for third-quarter delivery. Sulphuric acid was among the items for which revised sales schedules are reported. This is in distinct contrast with conditions existing a few years ago when stocks of acid were heavy and no stable price could be quoted as sales were being made at private terms and in the South particularly sales were made at about one-half the nominal quoted levels. At present and for some months unsold stocks of sul-

phuric acid have been light and a strong tone has existed in the market for several months.

Muriatic acid also has shown greater strength and this is true for mineral acids in general. For the last few years, prices for phosphates of soda have meant but little as contracts were placed at very low figures and practically every sales price depended upon the degree of competition for that particular business. Prices still are low based on production costs but buyers are not able to obtain supplies at the low levels that formerly were possible. Important fertilizer chemicals, such as nitrate of soda and sulphate of ammonia are bringing higher prices for current and forward deliveries.

Solvents have been under competitive selling for a long time and while this condition still exists the average level of prices has been affected by the rise in production although some buyers are reported to be covered for this year at prices fixed late last year.

Pigments, including zinc oxide, lithopone, and titanium dioxide have joined in the upward swing and most of the chemicals which depend on a metal base are following the price trends of the metal market.

Vegetable oils, on the other hand, have reversed the order of the preceding months and have dropped off sharply in price. Cottonseed oil which is the most important oil in the list from a tonnage standpoint is feeling the effects of a probable large supply of new crop seed and while crude oil is largely nominal in the absence of trading, refined oil has sold off and as new crop crude soon will be available, prospects do not favor any rise in values for the near future. Imported oils with the exception of rapeseed have been lowered in primary markets with a corresponding affect on values in domestic markets and the weighted index number for fats and oils dropped sharply during the last month.

The Bureau of Mines reports that due to steady gains in uses of borax, production of natural sodium sulphate last year established an all-time record. The output of sodium carbonates, sulphate, and borax from natural brines amounted to 468,233 short tons valued at \$7,599,046 or an increase of 16 per cent in quantity and 11 per cent in value compared with the preceding year. Production of natural sodium sulphate was 51,608 tons valued at \$336,559, the largest ever recorded. Sales of soda ash, bicarbonate, sesquicarbonate, and trona rose to 102,866 tons valued at \$1,106,364. Boron minerals were produced to

the extent of 313,759 tons valued at \$6,156,123 an increase of 15 per cent in quantity and 14 per cent in value over 1935.

Among developments in foreign markets reported to the Department of Commerce are:

The recovery of Dead Sea potash has almost doubled during the past two years judging from exports which aggregated 23,372 metric tons in 1936. The concession is being exploited by the Palestine Potash, Ltd., which has a 75 year lease on the deposits.

Production of coal-tar dyes in the United Kingdom has increased steadily during the past three years reaching a total of 62 million pounds in 1936 against almost 59 million pounds during the preceding year and 53 million pounds in 1934.

With the view to promoting a more economical use of soaps in order to conserve the national supply of fats and oils Germany has established official norm-sheets which give the particular type of softener suited to waters found in different parts of the country.

The price of Chilean natural nitrate being offered for sale in Germany has been reduced 30 per cent, retroactive to the first of the year, in order to meet a similar cut decreed in connection with domestic synthetic nitrogen several weeks ago. Notwithstanding Germany's immense capacity for producing synthetic nitrogen it permits Chile to supply approximately 3½ per cent of its domestic nitrogen requirements.

Germany's export trade in salt cake has been considerably influenced in recent years by the growth of kraft paper manufacturing in the southern part of the United States. More than 102,500 metric tons of salt cake were exported from Germany to the United States last year against 34,625 tons in 1932. In the first quarter of the current year Germany's exports of salt cake advanced further to 61,260 metric tons from 40,015 tons last year.

CHEM. & MET. Weighted Index of CHEMICAL PRICES

Base=100 for 1927

This month.....	90.14
Last month.....	88.73
July, 1936.....	86.21
July, 1935.....	87.23

Prices for chemicals moved upward for delivery over the third quarter of the year. Sulphuric and muriatic acids are included among the items advanced. Turpentine has been relatively weak and shows but little disposition to improve.

CHEM. & MET. Weighted Index of Prices for OILS AND FATS

Base=100 for 1927

This month.....	92.77
Last month.....	99.16
July, 1936.....	85.27
July, 1935.....	87.51

Lower prices were almost general in the market for oils and fats in the last month. Crude cottonseed oil is hardly better than nominal but the approach of new crop oil has reduced the bid price. Linseed oil has declined in price with a considerable drop in China wood prices.

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb.	\$0.06 - \$0.07	\$0.06 - \$0.07	\$0.08 - \$0.09
Acid, acetic, 28%, bbl., cwt.	2.53 - 2.78	2.53 - 2.78	2.45 - 2.70
Glacial 99%, drums	8.70 - 8.95	8.70 - 8.95	8.43 - 8.68
U. S. P. reagent	10.75 - 11.00	10.75 - 11.00	10.52 - 10.77
Boric, bbl., ton	105.00 - 115.00	105.00 - 115.00	105.00 - 115.00
Citric, kegs, lb.	25 - 28	25 - 28	27 - 30
Formic, bbl., ton	11 - 11 1/2	11 - 11 1/2	11 - 11 1/2
Gallie, tech., bbl., lb.	60 - 65	60 - 65	60 - 65
Hydrofluoric 30% carb., lb.	07 - 07 1/2	07 - 07 1/2	07 - 07 1/2
Lactic, 44%, tech., light, bbl., lb.	05 1/2 - 06 1/2	06 1/2 - 06 1/2	11 1/2 - 12
Muriatic, 18°, tanks, cwt.	1.05 - 1.10	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb.	05 - 05 1/2	05 - 05 1/2	05 - 05 1/2
Oleum, tanks, wks., ton	18.50 - 20.00	18.50 - 20.00	18.50 - 20.00
Oxalic, crystals, bbl., lb.	10 1/2 - 12	10 1/2 - 12	11 1/2 - 12 1/2
Phosphoric, tech., c'by., lb.	09 - 10	09 - 10	09 - 10
Sulphuric, 60°, tanks, ton	13.00 - 11.00	11.00 - 11.50	11.00 - 11.50
Sulphuric, 66°, tanks, ton	16.50 - 15.50	15.50 - 15.50	15.50 - 15.50
Tannic, tech., bbl., lb.	26 - 30	26 - 30	20 - 30
Tartaric, powd., bbl., lb.	24 1/2 - 25 1/2	23 1/2 - 24 1/2	24 - 25
Tungstic, bbl., lb.	2.75 - 2.50	2.50 - 2.75	2.50 - 2.75
Alcohol, Amyl.			
From Pentane, tanks, lb.	123 - 123	143 - 143	
Alcohol, Butyl, tanks, lb.	08 1/2 - 08 1/2	08 1/2 - 08 1/2	08 1/2 - 08 1/2
Alcohol, Ethyl, 190°f., bbl., gal	4.14 - 4.14	4.14 - 4.14	4.27 - 4.27
Denatured, 190 proof			
No. 1 special, dr., gal wks.	34 - 32	34 - 34	
Alum, ammonia, lump, bbl., lb.	03 - 04	03 - 04	03 - 04
Potash, lump, bbl., lb.	03 1/2 - 04	03 - 04	03 - 04
Aluminum sulphate, com bags cwt.	1.35 - 1.50	1.35 - 1.50	1.35 - 1.50
Iron free, bg., cwt.	2.00 - 2.25	2.00 - 2.25	2.00 - 2.25
Aqua ammonia, 26°, drums, lb.	02 1/2 - 03	02 1/2 - 03	02 1/2 - 03
tanks, lb.	02 1/2 - 02 1/2	02 1/2 - 02 1/2	02 1/2 - 02 1/2
Ammonia, anhydrous, cyl., lb.	16 - 15 1/2	15 - 16	15 - 16
tanks, lb.	04 1/2 - 04 1/2	04 1/2 - 04 1/2	04 1/2 - 04 1/2
Ammonium carbonate, powd tech., casks, lb.	08 - 12	08 - 12	08 - 12
Sulphate, wks., cwt.	1.425 - 1.425	1.425 - 1.425	1.25 - 1.25
Amylacetate tech., tanks, lb.	11 1/2 - 12	11 - 11 1/2	12 - 12
Antimony Oxide, bbl., lb.	16 - 16 1/2	16 - 16 1/2	13 - 14
Arsenic, white, powd., bbl., lb.	03 - 03 1/2	03 - 03 1/2	03 1/2 - 04
Red, powd., kegs, lb.	15 1/2 - 16	15 1/2 - 16	15 1/2 - 16
Barium carbonate, bbl., ton	52.50 - 57.50	52.50 - 57.50	56.50 - 58.00
Chloride, bbl., ton	72.00 - 74.00	72.00 - 74.00	72.00 - 74.00
Nitrate, cask, lb.	07 - 08	07 - 08	08 1/2 - 09
Blanc fixe, dry, bbl., lb.	03 1/2 - 04	03 1/2 - 04	03 1/2 - 04
Bleaching powder, f. o. b., wks., drums, cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, gran., bags, ton	46.00 - 51.00	44.00 - 49.00	44.00 - 49.00
Bromine, cs., lb.	36 - 38	36 - 38	36 - 38
Calcium acetate, bags	2.25 - 2.25	2.25 - 2.25	2.10 - 2.10
Arsenate, dr., lb.	06 1/2 - 07	06 1/2 - 07	06 - 07
Carbide drums, lb.	05 - 06	05 - 06	05 - 06
Chloride, fused, dr., del., ton	20.00 - 33.00	20.00 - 33.00	20.00 - 33.00
flake, dr., del., ton	22.00 - 35.00	22.00 - 35.00	22.00 - 35.00
Phosphate, bbl., lb.	07 1/2 - 08	07 1/2 - 08	07 1/2 - 08
Carbon bisulphide, drums, lb.	05 - 06	05 - 06	05 - 06
Tetrachloride drums, lb.	05 1/2 - 08 1/2	05 1/2 - 06	05 1/2 - 06
Chlorine, liquid, tanks, wks., lb.	2.15 - 2.15	2.15 - 2.15	2.15 - 2.15
Cylinders	05 1/2 - 06	05 1/2 - 06	05 1/2 - 06
Cobalt oxide, cans, lb.	1.67 - 1.70	1.41 - 1.41	1.41 - 1.51
Copperas, bags, f.o.b., wks., ton	15.00 - 16.00	15.00 - 16.00	15.00 - 16.00
Copper carbonate, bbl., lb.	10 1/2 - 19 1/2	11 1/2 - 19	11 1/2 - 16
Sulphate, bbl., cwt.	5.15 - 5.40	5.15 - 5.40	4.00 - 4.25
Cream of tartar, bbl., lb.	18 1/2 - 19	17 1/2 - 18	16 1/2 - 17
Diethylene glycol, dr., lb.	22 - 23	22 - 23	16 1/2 - 20 1/2
Epsom salt, dom., tech., bbl., cwt.	1.80 - 2.00	1.80 - 2.00	1.80 - 2.00
Ethyl acetate, drums, lb.	07 1/2 - 08	07 - 08	07 - 08
Formaldehyde, 40%, bbl., lb.	05 1/2 - 06 1/2	05 1/2 - 06 1/2	06 - 07
Furfural, dr., lb.	10 - 17 1/2	10 - 17 1/2	10 - 17 1/2
Fuel oil, ref. drums, lb.	16 - 18	16 - 18	16 - 18
Glauber salt, bags, cwt.	95 - 1.00	85 - 1.00	85 - 1.00
Glycerine, e.p., drums, extra, lb.	23 1/2 - 23 1/2	23 1/2 - 23 1/2	14 1/2 - 15
Lead:			
White, basic carbonate, dry casks, lb.	07 1/2 - 07 1/2	07 1/2 - 07 1/2	06 1/2 - 06 1/2
White, basic sulphate, csk., lb.	07 1/2 - 07 1/2	07 1/2 - 07 1/2	06 - 06
Red, dry, csk, lb.	08 1/2 - 08 1/2	08 1/2 - 08 1/2	07 - 07
Lead acetate, white crys., bbl., lb.	13 1/2 - 14	13 1/2 - 14	10 1/2 - 11
Lead arsenate, powd., bbl., lb.	11 1/2 - 12	11 1/2 - 12	09 - 10
Lime, chem., bulk, ton	8.50 - 8.50	8.50 - 8.50	8.50 - 8.50
Litharge, pd., csk., lb.	07 1/2 - 07 1/2	07 1/2 - 07 1/2	06 - 06
Lithophone, bags, lb.	04 1/2 - 04 1/2	04 1/2 - 04 1/2	04 1/2 - 05
Magnesium carb., tech., bags, lb.	06 - 06 1/2	06 - 06 1/2	06 - 06 1/2

The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to July 13

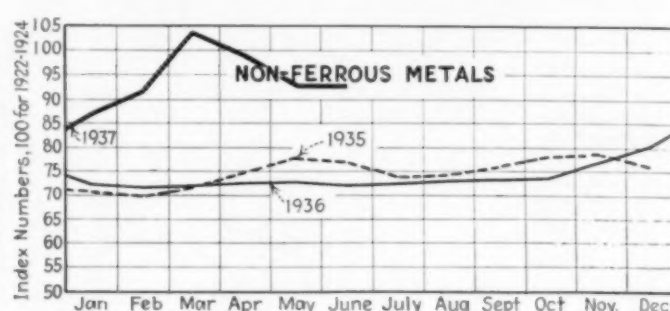
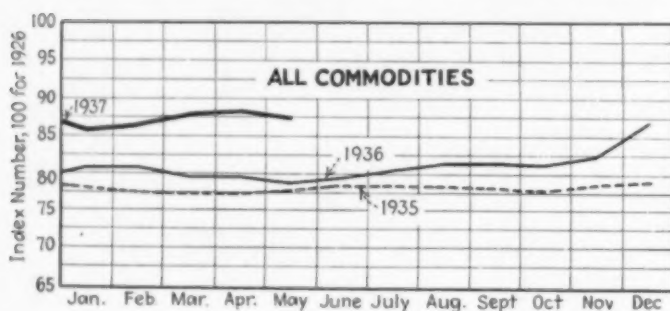
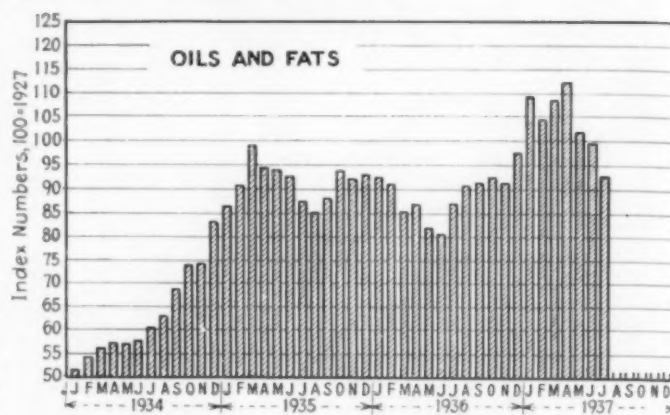
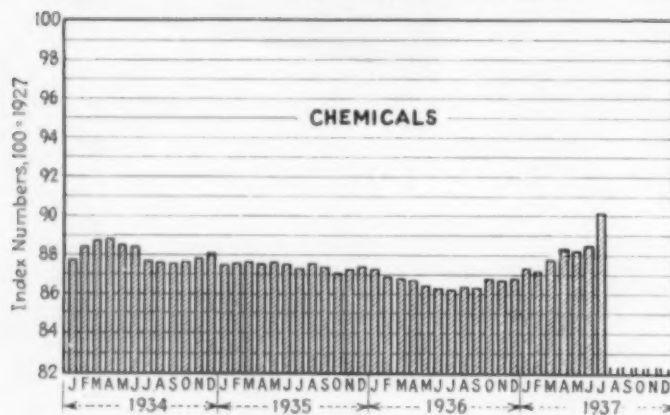
Current PRICES

	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal	31 - 31	31 - 31	33 - 33
97%, tanks, gal	32 - 32	32 - 32	34 - 34
Synthetic, tanks, gal	33 - 35 1/2	35 1/2 - 35 1/2	35 1/2 - 35 1/2
Nickel salt, double, bbl., lb.	13 - 13 1/2	13 - 13 1/2	13 - 13 1/2
Orange mineral, csk., lb.	11 1/2 - 11 1/2	11 1/2 - 11 1/2	10 - 10
Phosphorus, red, cases, lb.	40 - 42	40 - 42	44 - 45
Yellow, cases, lb.	24 - 30	24 - 30	28 - 32
Potassium bichromate, casks, lb.	08 1/2 - 09	08 1/2 - 09	08 1/2 - 09
Carbonate, 80-85%, calc. csk., lb.	06 1/2 - 06 1/2	06 1/2 - 06 1/2	07 - 07 1/2
Hydroxide, powd., lb.	09 1/2 - 09 1/2	08 1/2 - 09	08 - 08 1/2
Hydroxide (caustic potash) dr., lb.	07 - 07 1/2	07 - 07 1/2	06 1/2 - 06 1/2
Muriate, 80% bags, ton	23.00 - 23.00	23.00 - 23.00	22.00 - 22.00
Nitrate, bbl., lb.	05 1/2 - 06	05 1/2 - 06	05 1/2 - 06
Permanganate, drums, lb.	18 1/2 - 19	18 1/2 - 19	18 1/2 - 19
Prussiate, yellow, casks, lb.	15 - 16	15 - 16	18 - 19
Sal ammoniac, white, casks, lb.	05 - 05 1/2	05 - 05 1/2	04 1/2 - 05
Salsoda, bbl., cwt.	1.00 - 1.05	1.00 - 1.05	1.00 - 1.05
Salt cake, bulk, ton	13.00 - 15.00	13.00 - 15.00	13.00 - 15.00
Soda ash, light, 58%, bags, contract, cwt.	1.23 1/2 - 1.23 1/2	1.23 - 1.23	1.23 - 1.23
Dense, bags, cwt.	1.25 - 1.25	1.25 - 1.25	1.25 - 1.25
Soda, caustic, 76%, solid, drums, contract, cwt.	2.60 - 3.00	2.60 - 3.00	2.60 - 3.00
Acetate, works, bbl., lb.	04 1/2 - 05	04 1/2 - 05	04 1/2 - 05
Bicarbonate, bbl., cwt.	1.75 - 2.00	1.75 - 2.00	1.85 - 2.00
Bichromate, casks, lb.	06 1/2 - 07	06 1/2 - 07	06 1/2 - 07
Bisulphate, bulk, ton	15.00 - 16.00	15.00 - 16.00	15.00 - 16.00
Bisulphite, bbl., lb.	03 1/2 - 04	03 1/2 - 04	03 - 04
Chlorate, kegs, lb.	06 1/2 - 06 1/2	06 1/2 - 06 1/2	06 1/2 - 06 1/2
Chloride, tech., ton	12.00 - 14.75	12.00 - 14.75	12.00 - 14.75
Cyanide, cases, dom., lb.	16 1/2 - 17	16 1/2 - 17	15 1/2 - 16
Fluoride, bbl., lb.	07 1/2 - 08	07 1/2 - 08	07 1/2 - 08
Hyposulphite, bbl., cwt.	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Metaisilicate, bbl., cwt.	2.15 - 3.15	2.15 - 3.15	2.90 - 3.00
Nitrate, bags, cwt.	1.425 - 1.375	1.375 - 1.375	1.325 - 1.325
Nitrite, casks, lb.	07 - 08	07 - 08	07 - 08
Phosphate, dibasic, bbl., lb.	1.70 - 1.70	1.70 - 1.70	07 1/2 - 08 1/2
Prussiate, dr., lb.	10 - 11	10 - 11	11 1/2 - 12
Silicate (40° dr.) wks., cwt.	80 - 85	80 - 85	80 - 85
Sulphide, fused, 60-62%, dr., lb.	02 1/2 - 03 1/2	02 1/2 - 03 1/2	02 1/2 - 03
Sulphite, crys., bbl., lb.	02 1/2 - 02 1/2	02 1/2 - 02 1/2	02 1/2 - 02 1/2
Sulphur, crude at mine, bulk, ton	18.00 - 18.00	18.00 - 18.00	18.00 - 18.00
Chloride, dr., lb.	03 - 04	03 1/2 - 04	03 1/2 - 04
Dioxide, cyl., lb.	07 - 08	06 1/2 - 08	07 - 07 1/2
Flour, bag, cwt.	1.60 - 3.00	1.60 - 3.00	1.60 - 3.00
Tin Oxide, bbl., lb.	58 - 58	58 - 58	47 - 47
Crystals, bbl., lb.	41 1/2 - 40 1/2	40 1/2 - 40 1/2	34 - 34
Zinc chloride, gran., bbl., lb.	05 - 06	05 - 06	05 - 06
Carbonate, bbl., lb.	14 - 15	14 - 15	09 - 11
Cyanide, dr., lb.	36 - 38	36 - 38	36 - 38
Dust, bbl., lb.	08 1/2 - 08 1/2	08 1/2 - 08 1/2	06 1/2 - 07
Zinc oxide, lead free, bag, lb.	06 1/2 - 06 1/2	06 1/2 - 06 1/2	05 - 05
5% lead sulphate, bags, lb.	06 1/2 - 05 1/2	05 1/2 - 05 1/2	04 1/2 - 04 1/2
Sulphate, bbl., cwt.	3.15 - 3.60	3.15 - 3.60	2.65 - 3.00

OILS AND FATS

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	\$0.10 1/2 - \$0.11	\$0.10 1/2 - \$0.11	\$0.10 - \$0.11
Chinawood oil, bbl., lb.	12 1/2 - 12 1/2	13 - 13	19 1/2 - 19 1/2
Coconut oil, Ceylon, tanks, N. Y. lb.	05 1/2 - 05 1/2	06 1/2 - 06 1/2	04 1/2 - 04 1/2
Corn oil crude, tanks (f.o.b. mill), lb.	08 - 08	08 1/2 - 08 1/2	08 1/2 - 08 1/2
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	08 - 08	nom. - nom.	08 1/2 - 08 1/2
Linseed oil, raw car lots, bbl., lb.	11 - 11	11 1/2 - 11 1/2	10 1/2 - 10 1/2
Palm, casks, lb.	05 1/2 - 06	06 - 06	04 1/2 - 04 1/2
Peanut oil, crude, tanks (mill), lb.	08 - 09 1/2	09 1/2 - 09 1/2	08 1/2 - 08 1/2
Rapeseed oil, refined, bbl., gal.	95 - 93	93 - 93	63 - 63
Soya bean, tank, lb.	07 1/2 - 10	10 - 10	08 1/2 - 08 1/2
Sulphur (olive foots), bbl., lb.	11 1/2 - 12	12 - 12	08 - 08
Cod, Newfoundland, bbl., gal.	52 - 52	52 - 52	40 - 40
Menhaden, light pressed, bbl., lb.	09 - 11	11 - 11	06 1/2 - 06 1/2
Crude, tanks (f.o.b. factory), gal.	40 - 45	45 - 45	36 - 36
Grease, yellow, loose, lb.	07 1/2 - 08 1/2	08 1/2 - 08 1/2	05 1/2 - 05 1/2
Oleo stearine, lb.	09 - 09	09 - 09	08 1/2 - 08 1/2
Red oil, distilled, d.p. bbl., lb.	11 1/2 - 11 1/2	11 - 11	09 1/2 - 09 1/2
Tallow extra, loose, lb.	08 1/2 - 08 1/2	08 1/2 - 08 1/2	05 1/2 - 05 1/2

CHEM. & MET.'S WEIGHTED PRICE INDEXES



COAL-TAR PRODUCTS

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	\$0.52 - \$0.55	\$0.52 - \$0.55	\$0.60 - \$0.62
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.15 - .16	.15 - .16	.14 - .15
Aniline salts, bbl., lb.	.22 - .24	.22 - .24	.24 - .25
Benzaldehyde, U.S.P., dr., lb.	.85 - .95	.85 - .95	1.10 - 1.25
Benzidine base, bbl., lb.	.70 - .75	.65 - .67	.65 - .67
Benzoic acid, U.S.P., kg., lb.	.52 - .54	.52 - .54	.48 - .52
Benzyl chloride, tech., dr., lb.	.40 - .42	.40 - .42	.30 - .35
Benzol, 90%, tanks, works, gal.	.16 - .18	.16 - .18	.18 - .20
Beta-naphthol, tech., drums, lb.	.23 - .24	.23 - .24	.24 - .27
Cresol, U.S.P., dr., lb.	.12 - .13	.12 - .13	.11 - .11
Crotylic acid, 99%, dr., wks., gal.	.92 - 1.00	.92 - 1.00	.68 - .70
Diethylaniline, dr., lb.	.50 - .55	.50 - .55	.55 - .58
Dinitrophenol, bbl., lb.	.23 - .25	.23 - .25	.29 - .30
Dinitrotoluen, bbl., lb.	.15 - .16	.15 - .16	.16 - .17
Dip oil, 25%, dr., gal.	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, bbl., lb.	.32 - .36	.32 - .36	.38 - .40
H-acid, bbl., lb.	.50 - .55	.50 - .55	.65 - .70
Naphthalene, flake, bbl., lb.	.07 - .07	.07 - .07	.07 - .08
Nitrobenzene, dr., lb.	.08 - .09	.08 - .09	.08 - .10
Para-nitraniline, bbl., lb.	.45 - .47	.45 - .47	.51 - .55
Phenol, U.S.P., drums, lb.	.13 - .14	.13 - .14	.14 - .15
Picric acid, bbl., lb.	.35 - .40	.35 - .40	.30 - .40
Pyridine, dr., gal.	1.55 - 1.60	1.55 - 1.60	1.10 - 1.15
Resorcinal, tech., kegs, lb.	.75 - .80	.75 - .80	.65 - .70
Salicylic acid, tech., bbl., lb.	.34 - .40	.34 - .40	.40 - .42
Solvent naptha, w.w., tanks, gal.	.30 - .30	.30 - .30	.26 - .26
Tolidine, bbl., lb.	.88 - .90	.88 - .90	.88 - .90
Toluene, tanks, works, gal.	.35 - .35	.35 - .35	.30 - .30
Xylene, com, tanks, gal.	.35 - .35	.35 - .35	.30 - .30

MISCELLANEOUS

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	\$22.00 - \$25.00	\$22.00 - \$25.00	\$22.00 - \$25.00
Casein, tech., bbl., lb.	.13 - .14	.13 - .14	.15 - .17
China clay, dom., f.o.b. mine, ton.	8.00 - 20.00	8.00 - 20.00	8.00 - 20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.04 - .20	.04 - .20	.04 - .20
Prussian blue, bbl., lb.	.37 - .38	.37 - .38	.37 - .38
Ultramarine blue, bbl., lb.	.10 - .26	.10 - .26	.10 - .26
Chrome green, bbl., lb.	.21 - .37	.21 - .37	.21 - .37
Carmine red, tins, lb.	4.00 - 4.40	4.00 - 4.40	4.00 - 4.40
Para toner, lb.	.75 - .80	.75 - .80	.80 - .85
Vermilion, English, bbl., lb.	1.80 - 1.90	1.80 - 1.90	1.59 - 1.60
Chrome yellow, C. P., bbl., lb.	.14 - .15	.14 - .15	.12 - .14
Feldspar, No. 1 (f.o.b. N.C.), ton.	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.06 - .06	.06 - .06	.07 - .08
Gum copal Congo, bags, lb.	.08 - .30	.08 - .30	.08 - .30
Manila, bags, lb.	.08 - .14	.08 - .14	.08 - .14
Damar, Batavia, cases, lb.	.16 - .24	.15 - .23	.15 - .16
Kauri cases, lb.	.18 - .60	.17 - .60	.20 - .25
Kieselguhr (f.o.b. N. Y.), ton.	50.00 - 55.00	50.00 - 55.00	50.00 - 55.00
Magnetite, calc, ton.	50.00 - .	50.00 - .	50.00 - .
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.	9.35 - .	9.35 - .	6.25 - .
Turpentine, gal.	.39 - .	.39 - .	.41 - .
Shellac, orange, fine, bags, lb.	.23 - .	.24 - .	.25 - .
Bleached, bonedry, bags, lb.	.17 - .	.18 - .	.18 - .
T. N. Bags, lb.	.12 - .	.12 - .	.14 - .
Soapstone (f.o.b. Vt.), bags, ton.	10.00 - 12.00	10.00 - 12.00	10.00 - 12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
300 mesh (f.o.b. Ga.), ton.	7.50 - 10.00	7.50 - 10.00	7.50 - 11.00
225 mesh (f.o.b. N. Y.), ton.	13.75 - .	13.75 - .	13.75 - .

INDUSTRIAL NOTES

MATHIESON ALKALI WORKS, New York, has appointed Robert M. Mannheim as New England district manager with headquarters in Hospital Trust Bldg., Providence. Mr. Mannheim has been succeeded in the north New Jersey territory by James R. Harrington who in turn is replaced by Donald G. Ross.

WILSON & BENNETT MFG. CO., Chicago, has added J. R. Barnes to its sales organization in the New England and New York area.

AJAX FLEXIBLE COUPLING CO., Westfield, N. Y., has appointed Roloff Engineering Co. as its sales representative in Milwaukee.

ROOTS-CONNERSVILLE BLOWER CORP., Connerville, Ind., has appointed zone representatives as follows: J. J. Heinrichson, Kansas City, Mo.; Paul C. Rowe, Newark, N. J.; and Carl B. Sunderland, Muncie, Ind.

STRUTHER-WELLS CO., Warren, Pa., is now

represented in Pittsburgh by Goldsborough and Vansant, Inc.

GENERAL REFRACTORIES CO., Philadelphia, announces that the Tennessee Mill & Mine Supply Co. will act as distributor in Knoxville, Tenn.

THE MERCORD CORP., Chicago, is now represented in Oklahoma City, Okla., by the Loeffler-Greene Supply Co.

New CONSTRUCTION

Where Plants Are Being Built in Process Industries

	Current Projects		Cumulative 1937—	
	Proposed Work	Contracts	Proposed Work	Contract
New England.....	\$130,000	\$40,000	\$905,000	\$1,300,000
Middle Atlantic.....	1,230,000	1,630,000	12,252,000	9,016,000
South.....	6,140,000	1,040,000	10,505,000	23,771,000
Middle West.....	705,000	730,000	11,438,000	9,897,000
West of Mississippi.....	1,812,000	40,000	8,992,000	4,831,000
Far West.....	85,000	.....	3,285,000	4,978,000
Canada.....	590,000	.....	10,525,000	861,000
Total.....	\$10,692,000	\$3,480,000	\$57,902,000	\$54,654,000

PROPOSED WORK

Chemical Plant—Aylmer Chemical Co., Ltd., Aylmer, Ont., Can., Jesse C. Legg, Mgr., is having plans prepared for a manufacturing and refining plant. Estimated cost \$50,000.

Cotton Oil Mill—Robstown Oil Mill Co., Robstown, Tex., is having preliminary surveys made for a cotton oil mill in the Rio Grande Valley section near Robstown.

Distillery—Bourbon Distilling Co., c/o D. E. Fowler, 408 Citizens Bank Bldg., Lexington, Ky., plans to construct a distillery at Paris, Ky. Estimated cost \$100,000.

Factory—Aluminum Bronze Powder Co., Willis St., Bedford, O., contemplates rebuilding its plant. Estimated cost including equipment \$40,000. Maturity indefinite.

Factory—Aluminum Co. of Canada, Ltd., 153 Sterling Rd., Toronto, Ont., Can., is having plans prepared for a plant on Perth Ave., Toronto. Estimated cost will exceed \$40,000.

Factory—Church & Dwight, Amherstburg, Ont., Can., manufacturers of bicarbonate of soda, contemplate erecting and equipping additional factory buildings. Special equipment will be installed. Estimated cost \$100,000.

Factory—General Asbestos & Rubber Co., 61 Willett St., Passaic, N. J., plans to improve its plant at Charleston, S. C. Estimated cost including equipment \$40,000.

Factory—General Plastics, Inc., North Tonawanda, N. Y., plans to construct an addition to its plant. Estimated cost, \$150,000.

Factory—Johns-Manville Co., 22 East 40th St., New York, N. Y., has acquired the plant of the former Fibre Conduit Co., at Richmond, Ind., and plans to equip same for new insulation manufacture.

Factory—Linde Air Products Co., 30 East 42nd St., New York, N. Y., has purchased a site on West River Rd., Lorain, O., and contemplates the construction of a factory. R. S. Donnellon in charge of construction. Estimated cost will exceed \$40,000.

Factory—Mansfield Japanery Lacquer Products, Mansfield, Mass., plans alterations and repairs to its factory to replace fire damage. Estimated cost will exceed \$45,000.

Factory—National Aniline & Chemical Co., Abbott Rd., Buffalo, N. Y., will soon take bids for superstructures for factory building 229 and 230. Contract for foundations has been awarded to Hydro Construction Co., Stock Exchange Bldg., Buffalo, N. Y.

Gas Factory—Connecticut Gas Products Co., Inc., George J. Fouser, Vice Pres., New Haven, Conn., contemplates the construction of a factory on Main St., Meriden, Conn.

Gasoline Plant—Phillips Petroleum Co., Bartlesville, Okla., has acquired a 91 acre site at Goldsmith, Tex., and plans to construct a gasoline plant. Estimated cost \$1,750,000.

Glass Factory—Elias Glass Co., Corbin Ave., New Britain, Conn., has had plans prepared by Mylchreest & Reynolds, Architects, 235 Palm St., Hartford, Conn., for a 1 story, 100x160 ft. factory on Granby St., Hartford, Conn. Estimated cost \$45,000.

Glass Factory—Libbey Glass Co., Ash St. and Wheeling & Lake Erie R. R., Toledo, O., is having plans prepared by Forester, Wernert & Taylor, Engrs., Nicholas Bldg., Toledo, for a factory. Estimated cost \$500,000.

Laboratory—Indiana Steel Products Co., Valparaiso, Ind., is having plans prepared by A. Epstein, Engr., 2001 West Pershing Rd., Chicago, Ill., for the construction of a 2 story laboratory. Estimated cost \$45,000.

Laboratory—Shell Oil Co., Shell Bldg., San Francisco, Calif., is having plans prepared for an addition to its laboratory at Shell Point, Calif. Estimated cost \$45,000.

Leather Factory—Amsterdam Holding Co., c/o Leo Plaster, 1172 Reynolds Blvd., Newark, N. J., is having plans prepared for the construction of a factory at Amsterdam and Magazine Sts., Newark. Estimated cost \$40,000.

Match Factory—Diamond Match Co., Galt, Calif., plans to repair its plant recently damaged by fire. Estimated cost including equipment \$40,000.

Paper Mill—Provincial Paper Co., E. L. Goodall, Ch. Engr., Port Arthur, Ont., Can., is having plans prepared for improvements to its plant including additional finishing room equipment, rebuilding No. 2 paper machine and other alterations to machinery and equipment. Estimated cost \$200,000.

Paper Mill—Scott Paper Co., Thomas B. McCabe, Pres., Foot of Market St., Chester, Pa., will soon take bids for the construction of a 1 story addition to its mill. Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass., Engr. Estimated cost will exceed \$1,000,000.

Paper Mill—Southern Kraft Corp., c/o International Paper & Power Co., 220 East 42nd St., New York, N. Y., plans to construct a paper mill at Spring Hill, Webster Parish, La. Estimated cost \$6,000,000.

Roofing Factory—Globe Roofing Products Co., 176 West Adams St., Chicago, Ill., is having plans prepared for a 1 story, 40x300 ft. factory on Schrang St., Whiting, Ind.

Sulphuric Acid Plant—Ozark Chemical Co., Tulsa, Okla., plans to construct a sulphuric acid plant. Estimated cost \$22,000.

Tannery—Sun Leather Corp., c/o M. Greenblatt, K. C., 1255 University St., Montreal, Que., Can., contemplates the construction of a tannery. Estimated cost \$50,000.

Cyanide Mill—Kerr-Addison Gold Mines, Ltd., 11 King St. E., Toronto, Ont., Can., plans to construct a 500 ton per day cyanide mill at Larder Lake, Ont. Estimated cost \$150,000.

Machinery—Waverly Sugar Factory, Thibodeaux, La., is having plans prepared by A. F. Delbert, Engr., 3335 Daneel St., New Orleans, La., for installing additional machinery in its factory.

CONTRACTS AWARDED

Benzol Refining Plant—Carnegie Illinois Steel Corp., Carnegie Bldg., Pittsburgh, Pa., has awarded the contract for the construction of a benzol refining plant (to be largest of its kind) at Clairton, Pa., to Semet-Solvay Engineering Corp., 40 Rector St., New York, N. Y.

Brass Factory—American Brass Co., 70 Sayre St., Buffalo, N. Y., has awarded the contract for an addition to its factory to T. Franklin, Jackson Bldg., Buffalo.

Chemical Factory—Mutual Chemical Corp. of America, Block and Willis Sts., Baltimore, Md., has awarded the contract for a chemical factory to Davis Construction Co., 9 West Chase St., Baltimore. Estimated cost \$45,000.

Chemical Factory—Oldbury Chemical Co., Buffalo Ave., Niagara Falls, N. Y., has awarded the contract for a service building and laboratory to Wright & Kremers, Inc., Main St. and Pine Ave., Niagara Falls. Estimated cost \$40,000.

Factory—Allied Asphalt & Mineral Corp., Dunellen, N. J., has awarded the contract for a new still building and repairs to three other buildings to F. S. Closson, 450 Seventh Ave., New York, N. Y. Estimated cost \$50,000.

Factory—American Viscose Corp., Front Royal, Va., has awarded the contract for a factory to Wark Co., 1608 Walnut St., Philadelphia, Pa. Estimated cost \$1,000,000.

Factory—Clifton Paperboard Co., Clifton, N. J., has awarded the contract for a factory to Austin Co., 19 Rector St., New York, N. Y. Estimated cost will exceed \$40,000.

Factory—Linde Air Products Co., 230 North Michigan Ave., Chicago, Ill., has awarded the contract for a 1 and 2 story, 110x115 ft. factory to F. W. Sproul, 2001 West Pershing Rd., Chicago. Estimated cost \$40,000.

Factory—National Aniline & Chemical Co., Abbott Rd., Buffalo, N. Y., has awarded the contract for factory buildings No. 231 and 232 to Metzger Construction Corp., 429 Carlton St., Buffalo.

Gas Plant—Wisconsin Gas & Electric Co., Racine, Wis., has awarded the general contract for the construction of a gas plant to United Gas Improvement Co., 1401 Arch St., Philadelphia, Pa. Estimated cost \$500,000.

Glass Factory—Pittsburgh Plate Glass Co., Pittsburgh, Pa., has awarded the contract for the construction of a resin plant to Kroening Engineering Corp., 4500 West Mitchell St., Milwaukee, Wis. Estimated cost \$185,000.

Grease Factory—Socony Vacuum Oil Co., 25 Bway., New York, N. Y., has awarded the contract for an addition to its grease and compounding building at Venango, Pa., to L. O. Boquin, 13 East First St., Oil City, Pa.

Oil Refinery—Frontier Fuel Oil Co., Ellicott Sq., Buffalo, N. Y., has awarded the contract for an oil refinery to have a capacity of 40,000,000 gal. annually to Frontier Engineering Corp., Ellicott Sq., Buffalo. Estimated cost \$150,000.

Paper Mill—Kimberly-Clark Corp., Nee-nah, Wis., has awarded the contract for alterations to paper mill Bldg. No. 34 and addition to factory building to Ben B. Ganther Co., Oshkosh.

Rayon Mill—Virginia Rayon Mills, Orange Va., have awarded separate contracts for the construction of a 2 story, 70x120 ft. addition to their mill. Estimated cost will exceed \$40,000.

Rubber Factory—Goodrich Tire & Rubber Co., Akron, O., has awarded the contract for a 3 story, 40x115 ft. factory to Carmichael Construction Co., Akron. Estimated cost \$150,000.

Silk Mill—Courtaulds Canada, Ltd., Cornwall, Ont., Can., has awarded the contract for a silk mill to Foundation Co. of Canada, Ltd., Montreal, Que., Can. This is part of \$3,000,000 expansion program.

Tannery—A. C. Lawrence Leather Co., Sawyer St., Peabody, Mass., has awarded the contract for a tannery and pickling plant addition to E. H. Porter Construction Co., 13 Wallis St., Peabody, Mass. Estimated cost \$40,000.

Varnish Factory—Benjamin Moore & Co., 1630 South Second St., St. Louis, Mo., has awarded the contract for a varnish factory and shipping room to Gamble Construction Co., 620 Chestnut St., St. Louis, Mo.

Distilling Equipment—Rochester Distilling Corp., Exchange St., Rochester, N. Y., has awarded the contract for distilling equipment and machinery for new plant to Dahlquist Manufacturing Co., 40 West Third St., Boston, Mass.

RAPID GROWTH IN WORLD PRODUCTION OF CHEMICAL NITROGEN

A SURVEY of chemical nitrogen has recently been released by the U. S. Tariff Commission. It deals with the different processes of production, the organization of the world industry, and the trade in the principal products into which chemical nitrogen enters. The survey defines chemical nitrogen as nitrogen obtained from the air, or from coal or other mineral products by manufacturing processes. It does not include so-called organic nitrogen occurring in vegetable and animal matter and the waste products thereof.

The study brings into strong relief, the importance of the atmosphere as a source of chemical nitrogen. In 1900 the entire world production of chemical nitrogen was from mineral sources with Chilean sodium nitrate accounting for 66.6 per cent of the output and the remaining 33.4 per cent coming from coal processing. In 1934 nearly three-quarters of world production resulted from air fixation, the proportions being 74.5 per cent from air, 18.6 per cent from coal, and only 6.9 per cent from Chilean sodium nitrate.

Economic reasons for this change were the changing relative efficiency, adaptability, and comparative costs of the processes by which nitrogen is recovered or produced from these different sources. The political aspect was the determination on the part of leading nations to control a supply of nitrogen sufficient for their own needs.

In recent years 65 to 80 per cent of the world's chemical nitrogen has been produced initially in the form of ammonia, 10 per cent as calcium cyanamide, and 5 to 20 per cent as natural sodium nitrate. It is estimated that only 10 to 15 per cent of the ammonia output is marketed directly as such, to

be used for refrigeration, ammoniation, as an alkali, etc.

World capacity for primary production of chemical nitrogen increased from 380,000 tons in 1900 to 1,507,000 tons in 1918, the increase being mainly in the byproduct and air nitrogen branches of the industry. For the next four years, production turned downward due largely to discontinuance of a number of cyanamide plants. Beginning in 1923, world capacity increased at the rate of 12.6 per cent annually until 1931 when 4,448,000 tons was reached.

Increase in world capacity since 1931 has been slower and almost entirely in synthetic ammonia plants, bringing total capacity by 1934 to 5,082,000 tons. A breakdown of world capacity shows

about 105 plants for production of synthetic ammonia, about 4,500 byproduct plants, some 41 cyanamide plants, and about 75 plants in Chile. These plants range in size from about 100 tons annually to 715,000 tons for the largest synthetic plant. The replacement value of these plants distributed over 21 countries is estimated to exceed one billion dollars.

World Productive Capacity for Chemical Nitrogen as of January, 1934

Country	Synthetic per cent	Cyanamide per cent	By-product per cent	Chilean per cent	Total per cent
Germany.....	22.3	3.9	2.7	.....	29.0
Chile.....	.....	.....	.....	13.6	13.6
United States.....	6.7	.....	3.9	.....	10.6
Great Britain.....	5.3	.....	2.4	.....	7.7
France.....	5.4	0.9	1.0	.....	7.2
Japan.....	4.3	1.4	0.2	.....	5.9
Belgium.....	4.0	0.1	0.5	.....	4.7
Soviet Union.....	3.6	0.1	0.3	.....	4.0
Italy.....	2.4	0.4	0.1	.....	3.0
Netherlands.....	2.4	.....	0.2	.....	2.6
Norway.....	2.3	0.3	.....	.....	2.6
Canada.....	0.7	1.5	0.2	.....	2.5
Poland.....	1.4	0.8	0.1	.....	2.3
Other.....	2.8	1.2	0.6	.....	4.3
Total.....	63.6	10.6	12.2	13.6	100.0

Chemical Nitrogen Compounds Used as Fertilizers

Product	Country of manufacture	Nitrogen N per cent	Phosphorous pentoxide P ₂ O ₅ per cent	Potash K ₂ O per cent
Ammonium sulphur-nitrate or Leunasaal peter or Montansaal peter.....	Germany.....	26	.....	.....
Ammonophos (A).....	United States.....	10.7	48.0	.....
Ammonophos (B).....	United States.....	16.5	20.0	.....
Diammonium phosphate and ammonium sulphate or Leunaphos.....	Germany.....	20.0	20.0	.....
Nitrophoskas:				
I (U. S. I).....	Germany.....	17.5	13.0	22.0
II (U. S. IV).....	Germany.....	15.0	11.0	26.5
III (U. S. II).....	Germany.....	16.5	16.5	21.5
A (U. S. I).....	Germany.....	15.0	30.0	15.0
C (U. S. III).....	Germany.....	15.5	15.5	19.5
Potassium ammonium nitrate or Kalammonsal peter.....	Germany.....	16.0	.....	28.0
Nitropotasse.....	France.....	16.5	.....	25.0
Phosphazote.....	Switzerland.....	7.0	15.0	.....
Potazote (A).....	France.....	12.0	.....	24.0
Potazote (B).....	France.....	14.0	.....	20.0
Urea-ammonia liquor.....	United States.....	45.5	.....	.....
Crude nitrogen solution.....	United States.....	44.4	.....	.....
Nitrogen solution II.....	United States.....	37.5	.....	.....
Ammonitrol.....	France.....	15.5	13.0	.....
Cal-nitro or Kalkammonsalpeter.....	Germany.....	20.5	35.0	.....
Nitrochalk.....	Great Britain.....	16.0	46.5	.....
Calciumnitrate-urea or calurea.....	Germany.....	34.0	13.0	.....

¹ Numbers when designated for export to the United States.

Estimated Cost of Nitrogen Fixation by Processes¹
Per Short Ton of Product or of Nitrogen Content as Specified.

	With electrolytic hydrogen based on 26,000 tons ammonia capacity		With water-gas hydrogen based on 200,000 tons ammonia capacity		Coke-oven gas hydrogen based on 20,000 tons ammonia capacity		Cyanamide process		Arc process. Nitrogen 20 per cent as sodium nitrate; 80 per cent as nitric acid
	Ammonia	Nitrogen content of ammonia	Ammonia	Nitrogen content of ammonia	Ammonia	Nitrogen content of ammonia	Calcium cyanamide	Nitrogen content of cyanamide	
Capital cost per ton year.....	\$200.00	\$240.00	\$155.00 ²	\$188.00 ²	\$145.00	\$177.00	\$85.00	\$360.00	\$600.00
Operating expense:									
Amortization of capital cost, interest, taxes charged at 15 per cent.....	30.00	36.00	23.25	28.20	21.75	26.55	12.75	54.00	90.00
Power consumption, per ton....	24.11	29.28	5.00	6.00	8.00	9.75	8.50	36.00	91.50
Other operating and maintenance costs including royalties.....	18.83	22.87	26.75	32.00	31.75	38.25	12.35	52.50	60.00
Total estimated costs.....	\$72.94 ³	\$88.15 ³	\$55.00 ²	\$66.20 ²	\$61.50 ²	\$74.55 ²	\$33.60	\$142.50	\$241.50

¹ Based in part upon known costs and upon calculated costs. ² The high plant capacity is in part responsible for low capital cost. ³ Does not include any allowance for byproduct oxygen produced. ⁴ Borchardt estimates German cost to be \$51.84 and \$62.40 respectively.